CANADIAN ELECTRONICS ENGINEERING

APRIL 1960
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Silicon junction devices detect nuclear particles 26

Cold cathode tube drives decade counter 29

New microwave system provides light route service ... 30

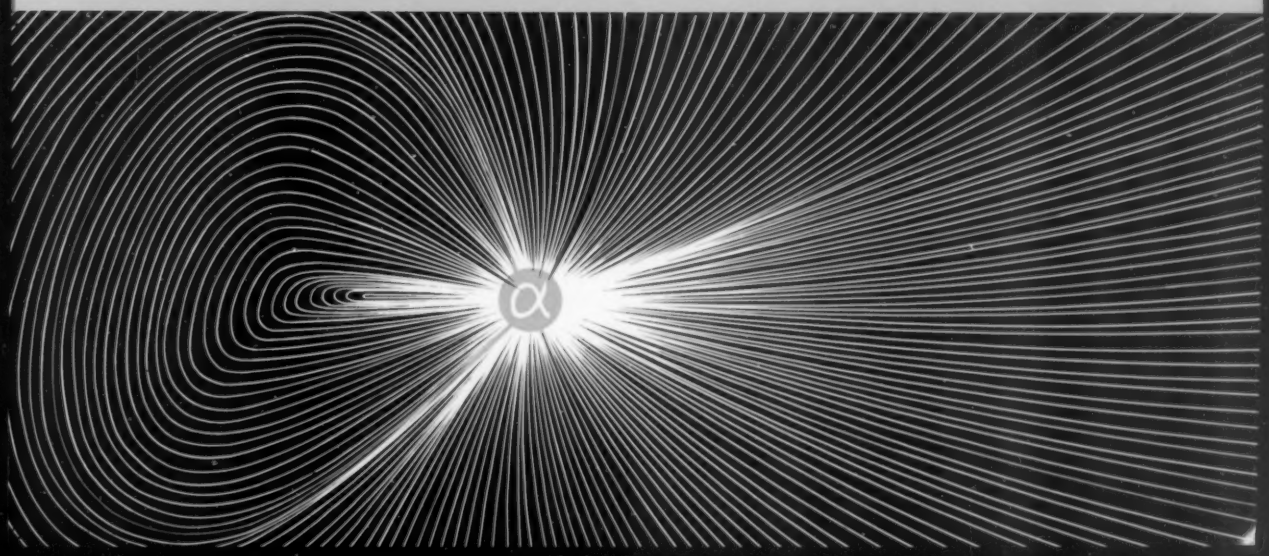
Problems of transAtlantic television transmission 34

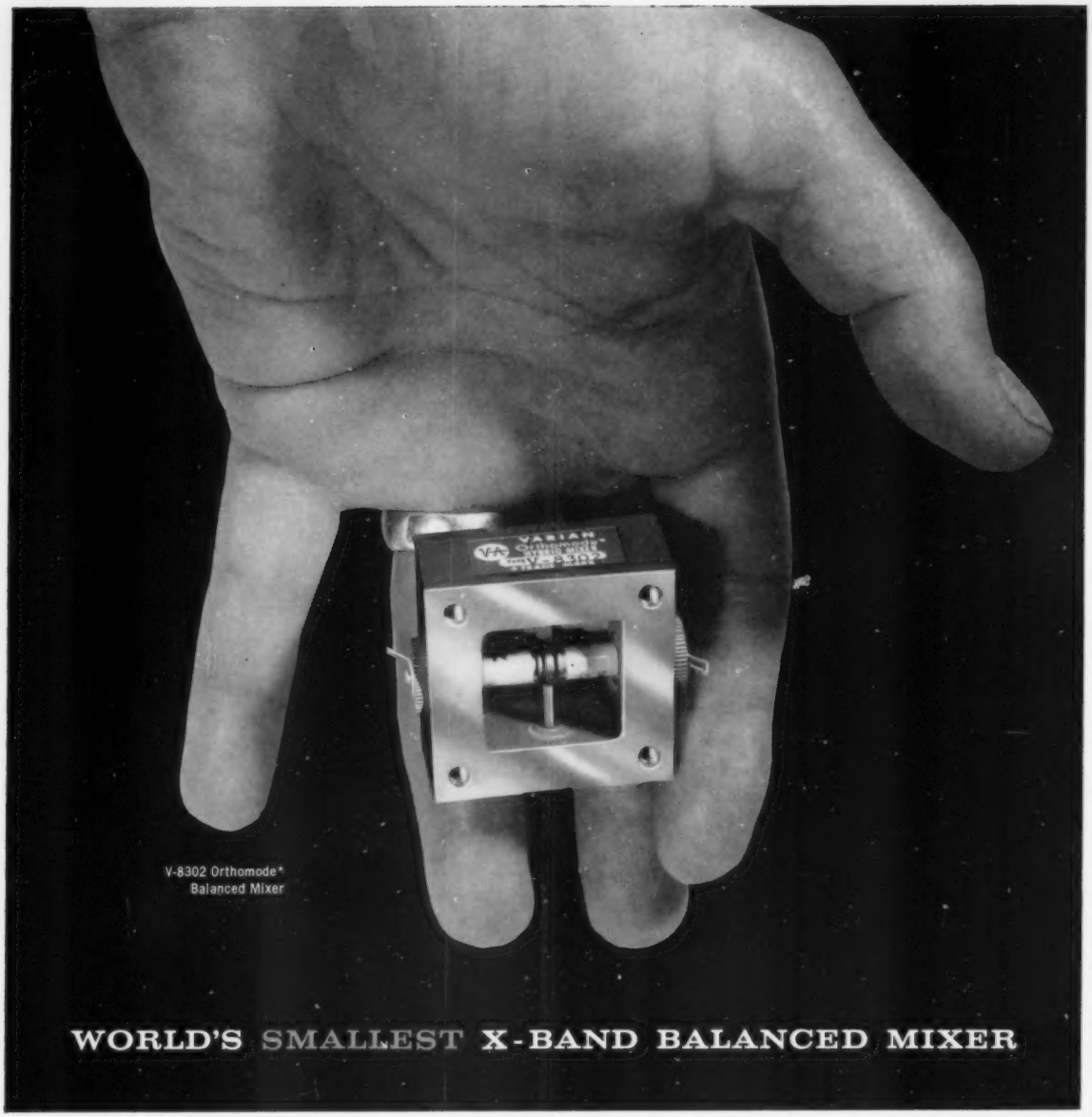
U. K. electronic exports to Canada growing 39

Photocells control unattended acetylene lights 40

full contents 1

APR 14 1960





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April, 1960

CANADIAN ELECTRONICS ENGINEERING

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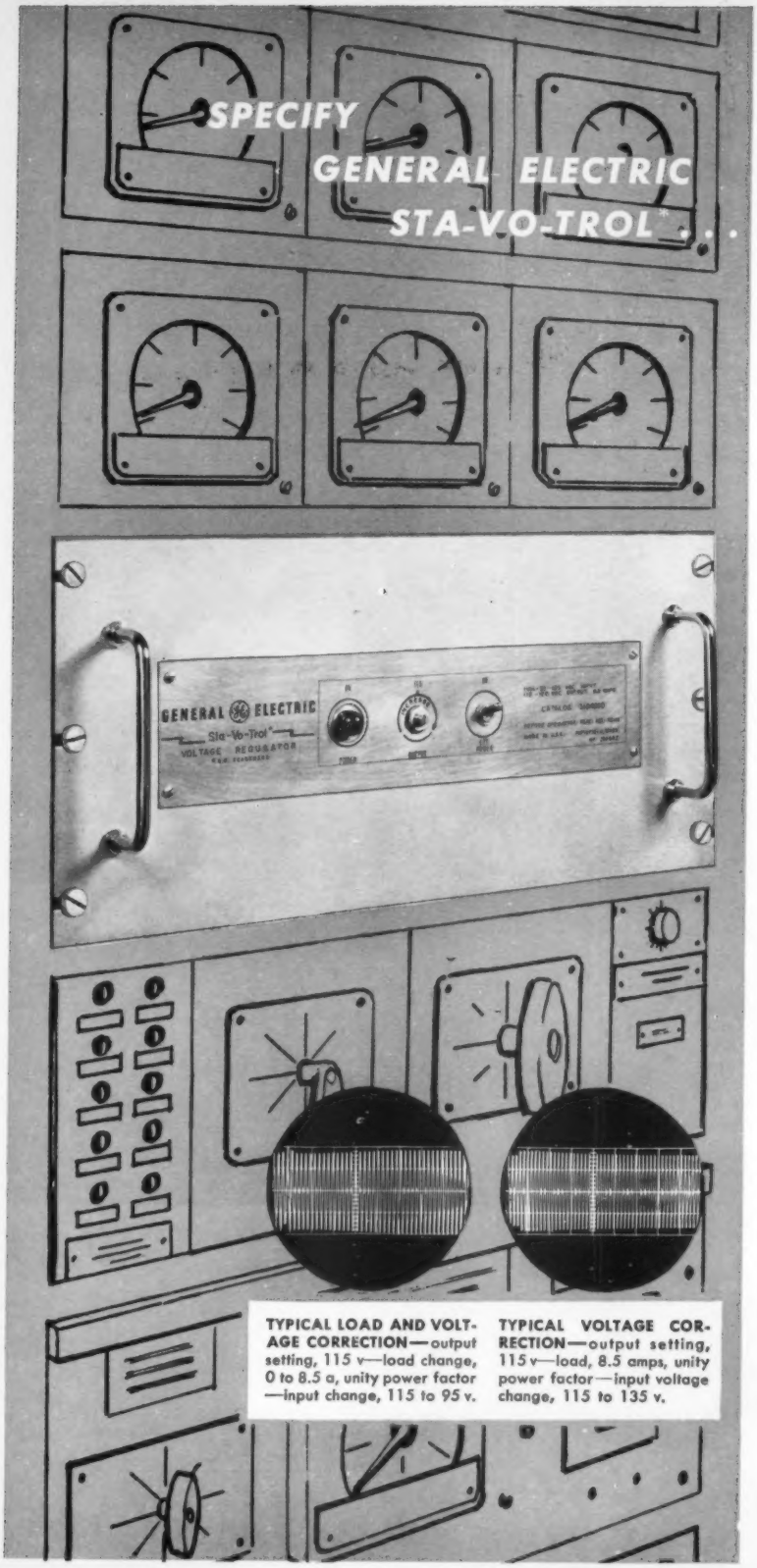
*cover design

For this month's cover, Art Director Frank Davies, an expert on typography, instinctively found a strong relationship between the Greek letter alpha and a visual interpretation of radiation.

†new department in this issue



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New General Electric Sta-Vo-Trol* regulator gives you maintenance-free, automatic, *static* voltage control using unique rate feedback and industry-proven zener diode sensing.

Static components eliminate tubes, brushes, and other moving parts.

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- Rating: 1 Kva output, 0 to 8.5 amperes, single phase, 60 cycles ±5%
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- Response time: 6 to 12 cycles‡
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- Wave-form distortion: 3%

† ±0.25% bandwidth for any line and load changes at constant power factor; ±0.5% bandwidth for changing load power factor.

‡ 6 to 12 cycles for 63% correction after ordinary line and/or load changes; up to 30 cycles for complete correction.

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authors and articles in this issue:

Ray W. Jackson (Silicon junction devices detect nuclear particles) is head of the Semiconductor Laboratory of RCA Victor Research Laboratories in Montreal. He joined the group four years ago after a period of five years in the U. S. at Yale University and with the Sprague Electric Co. Dr. Jackson received his Ph.D. in nuclear physics at McGill University in 1950 for his work in synchrocyclotron electronics. He obtained his B.A.Sc. from the University of Toronto in 1944.

RATTEN

Jackson

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Webb

Paul P. Webb, co-author of the silicon junction paper graduated from McGill University in 1955 with the B.Eng. degree in Engineering Physics, then obtained his M.Sc. from the University of London, Imperial College in 1957. He specialized in vapor diffusion processes and the construction of very high frequency transistors.

John E. A. Yeats (New 11 kmc microwave system provides short haul, light route service), also born and educated in England, was employed by the British Post Office, communications branch, and the RAF. He came to Canada in 1948 to work with Northern Electric Co., first in installation and engineering departments, then in systems engineering of transmission equipment.

During the Royal Tour last year, Canadians witnessed a major step toward transAtlantic television transmission. Two authors, **R. J. Halsey and A. R. A. Rendall** describe some of the technical aspects in their paper "Problems of transAtlantic television transmission by undersea cable." Mr. Halsey, CMG, was appointed Director of Research of the United Kingdom General Post Office in 1955 after serving a number of years with GPO in engineering capacities associated with landline and submarine cable transmission.

Dr. Rendall received his Ph.D. from the University of London in 1936, after working a number of years with the Standard Organisation. In 1935 Dr. Rendall joined the British Broadcasting Corporation in the Lines Dept. In 1947 he became assistant head of the Designs Dept., and was promoted to head of the department in 1950. He was awarded the OBE in 1957.

The paper "Photo cells control acetylene lights in unattended lighthouses" was prepared by three authors. **H. Ross Smyth** started his radio career as radio operator and official historian of the "Fort James" expedition to King William Land in 1928. He was the operator who contacted the eight lost McAlpine fliers in the fall of 1929 and directed the search planes. Later, Mr. Smyth continued his university studies at McGill where he played a prominent part in assembling equipment for making radio measurements during the solar eclipse of 1932. He received his B.Eng. degree in 1932, then worked in the development and standards lab. of RCA Victor Co. Ltd. In 1936 he joined the NRC and was awarded the MBE for his contribution in development of the 268 Naval Surface Search Radar.

NAT. RESEARCH COUNCIL

Beaulieu, Barnes and Smyth

J. C. Barnes graduated from the University of Toronto with the degree of M.A.Sc. in mechanical engineering. He has worked with Ontario Hydro on transmission lines, and with Canadian Marconi Co. on the design of crystal grinding machinery. In 1943 he joined the NRC to work on the design of military and commercial radar equipment.

R. Beaulieu graduated from Laval University in 1958 with a B.Sc. degree. He joined the staff of the NRC after graduation and has been working on navigational aids since that time.

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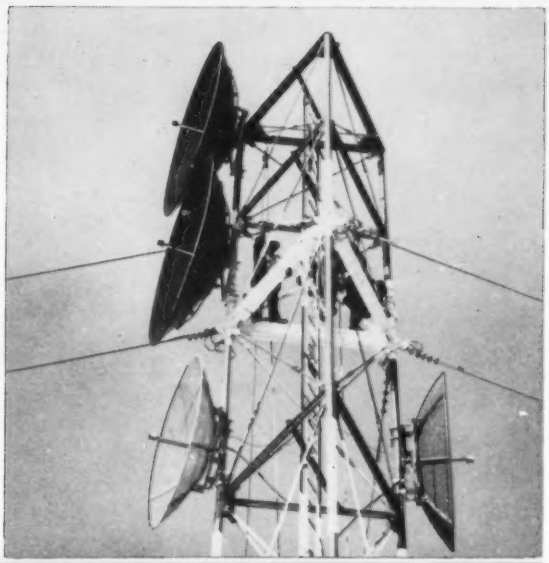
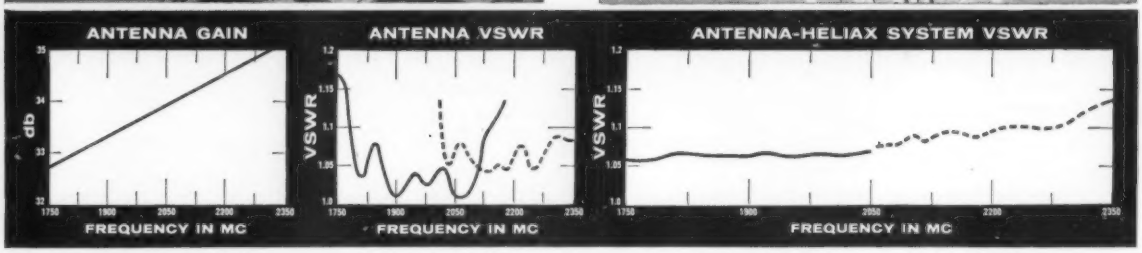




Antenna performance based on 60% gain factor

High and low band antenna VSWR plots of production test samples

Test results of high and low band production antennas and 110 feet of 7/8 inch HELIAX cable

A 600-channel microwave system to carry vital defence data was recently developed by Canadian-Marconi Company for the Royal Canadian Air Force. Because of its strategic value, this long haul line-of-sight system demanded reliable performance in the antenna equipment.

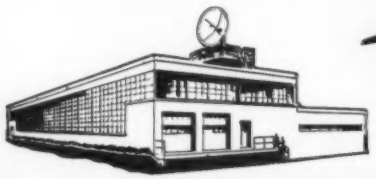
ANDREW Antenna Corporation, Ltd. is proud to have been chosen to design and produce this equipment to meet specific system requirements.

ANDREW microwave antenna, Type 21362, designed for this 1790-2260 mc system guaranteed a VSWR under 1.1. Minimum antenna gain of 33 db resulted from production models having gain factors of better than 60%. The antenna characteristics were sustained in the system through the use of ANDREW HELIAX, the flexible air dielectric cable. HELIAX was chosen for its low VSWR and attenuation, ease of handling and mechanical stability.

Automatic pressurizing equipment to regulate the dry air supply for this RF system was provided with an ANDREW Type 1910 dehydrator.

This is just one of many ANDREW antenna system installations in Canada that are consistently giving optimum performance in UHF/VHF and microwave frequencies. To get all the facts on ANDREW antenna systems, write or call today, giving your specific requirements.

Be sure and visit us at Booth #1502-1504 at the New York I.R.E. Show.



Andrew

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$96.3 million worth of U. S. prime defense contracts and subcontracts were placed in Canada during 1959.

A statement tabled in the Commons during February by Defence Production Minister O'Hurley included this record figure. It compares with $37.9 million for 1958 and the previous high of $58.7 million for 1957. It is estimated that electronics contracts accounted for about one third of the total in 1959—emphasis on R & D is essential if the flow of orders is to continue.

"1960 will be first big trade-in year for television" — Stuart D. Brownlee, Canadian Admiral president.

Forecasting an exciting future in the television replacement market, Mr. Brownlee listed these useful figures: 250,000 TV sets over eight years old; 750,000 over seven years old; 1,250,000 over six years old; and two million over five years old.

The U. S. Air Force has awarded a contract to Tracerlab to study use of X-rays in space communications.

The U. S. Air Force is interested in the possible use of X-rays as a means of space communications. They have properties which make them well suited for communications in the vast distances of outer space, and utilization of this type of radiation could supplement conventional systems.

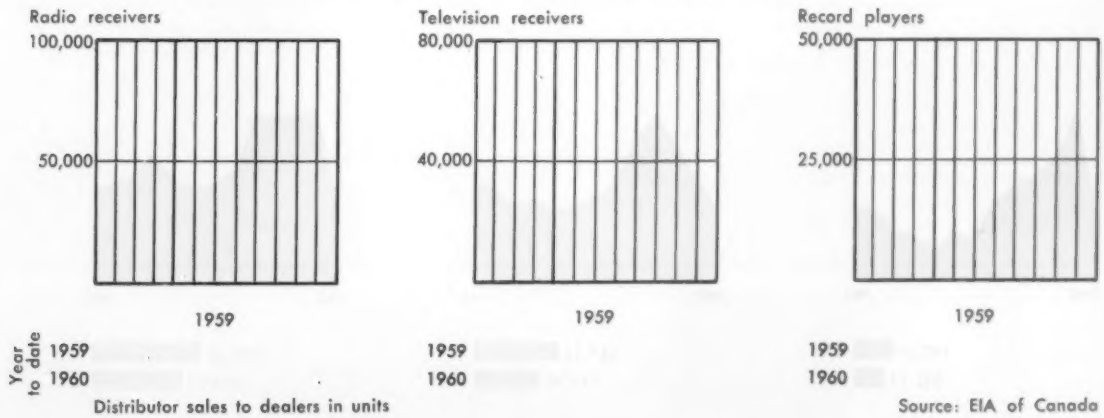
RCA Victor is building microwave equipment for Brazilian communications link on "crash" program basis.

Having won the contract over bids of competing companies in the United States, England, France, and Germany, RCA Victor are now constructing in their Montreal plant the 120-channel equipment that will link Brazil's new capital to the outside world. The 810-mile system will have 26 relay stations and, like the city itself, is being built as a "crash" project, since it must be in operation by April 15.

Board of Broadcast Governors makes recommendations for three commercial television station licenses.

After weighing submissions made at its March hearings, the BBG has recommended to the Minister of Transport approval of the following applications: Montreal, French language, Paul L'Anglais and Associates; Montreal, English language, Canadian Marconi Co.; Toronto, Baton Aldred Rogers Broadcasting Ltd. Although there were only two applicants for each of the Montreal licenses, nine vied for the second channel in Toronto, which will meet stiff competition from three other Canadian and three United States stations.

January radio, tv, and record player sales all below 1959 levels



Distributor sales to dealers in units

Source: EIA of Canada

SILICONE NEWS from Dow Corning

NEW: "Solid-State" Fluid

PHOTO COURTESY CBS LABORATORIES

Now: Potted Protection Plus Visual & Instrument Checking

The newest development in potting and encapsulating materials is Dow Corning Dielectric Gel. Supplied as a crystal clear fluid plus catalyst, it pours easily into assemblies and sub-assemblies, fills every void, sets up to a firm, pliable, transparent gel. The gelled mass exerts virtually no stress on components; has excellent adhesion; will not displace if vibrated or inverted. Potted components and connections are visible, probes can be inserted through it for instrument checking. When probes are removed, the gel heals itself, leaving no voids.

Here's how Dielectric Gel aids miniaturization: When designing the high voltage power supply for their new Photoscan airborne reconnaissance system, CBS Laboratories Division of Columbia Broadcasting System Inc., had to meet stringent reliability requirements despite elevated temperatures, high vibration levels, severe size and weight limitations. Their new design and miniaturization techniques were made possible by Dielectric Gel.

Requiring only 0.09 cubic feet complete, with components spaced less than ¼" apart without danger of arcing, the new power supply provides output voltages that can be regulated from 1,000 to 25,000 volts. Current capacity at 25 kv is well over 100 microamperes. This power supply is an integral part of Photoscan, a universal visual intelligence-gathering, processing and transmitting system which can readily be installed in virtually any missile or air-borne vehicle. The units are small, light in weight, simple to install and service.

PROPERTIES OF CURED DIELECTRIC GEL

Color	Water	White
Specific Gravity at 25 C		0.970
Coefficient of Thermal Conductivity:		
(cal per cm °C sec) 150 C		0.00070
200 C		0.00078
Electric Strength*, volts per mil		800
Dielectric Constant†	23 C	150 C
100 cps - 0.1 Mcs	3.0	2.6
Dissipation Factor†		
100 cps	0.0005	0.002
1.0 kc	0.0005	0.0005
0.1 Mcs	0.0001	0.0001
Volume Resistivity†, ohm-cm	1×10^{15}	1×10^{14}

* 60 cycles, rapid rise, 0.020 inch-spacing of 0.5 inch-diameter spherical electrodes.

† Using 54 mmfd fixed air capacitor, Cardwell type, ER-50-FS as electrodes, ASTM D150-54T and D1169-52T.

Dielectric Gel, plus CBS Laboratories packaging techniques simplify volume production problems . . . assure high voltage power supplies that are compact, reliable and easy to service.

Write for more information on Dow Corning Dielectric Gel, the new potting material that permits visual and instrument checking of potted electronic circuitry and simplifies production problems.

Your nearest Dow Corning office is the number one source for information and technical service on silicones.

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Three vice-presidents appointed at RCA Victor Company

J. D. Houlding, president, RCA Victor Co. Ltd., has announced the following appointments to newly-created vice-presidential positions.

F. J. O'Hara is vice-president of the Electronic Tube and Semiconductor division. He has been general manager of the division since 1957.

J. G. Sutherland is vice-president of RCA Victor Technical Products Division. He has been general manager of the division since 1958, and was responsible for engineering products, research and defense systems.

G. L. Mansour is vice-president, Consumer Products. He will have full responsibility for all product development marketing, manufacturing, distributing and administrative activities pertaining to consumer products. Mr. Mansour was formerly vice-president and general manager of the Record division.

RCAF Officer joins National Research Council

Ralph E. McBurney, formerly Air Officer Commanding Air Materiel Command, Ottawa, has been appointed head of the Technical Information Service of the National Research Council. The position at the NRC was made vacant by the retirement in March of F. G. Green, head of the section since 1950.

Since his retirement from the RCAF in 1952, Mr. McBurney has managed a division of Rogers Majestic Electronics Ltd., before establishing his practice as industrial consultant in Ottawa. In his new position with NRC he will be in charge of a program of technical aid to industrial firms in Canada.

Mr. McBurney was born in Montreal and educated in Saskatoon, including pre-engineering studies. He graduated from the University of Manitoba in 1930 with a degree in electrical engineering. At 18 he began to train as a pilot with the RCAF. In 1936 he became the first RCAF Telecommunications Officer, after which he formed the Telecommunications Branch of the Air Force. He acted for the Air Force in initiating the prewar manufacture in Canada of RCAF radio equipment, and, in the early years of the war, of British radar equipment which was later produced in Canada on a large scale.

In 1943 Mr. McBurney commanded the largest RCAF station, at Trenton. He was promoted to Air Vice Marshal in 1945 and was appointed to form the Air Materiel Command at Ottawa. During the war he was awarded the C.B.E. and the Canadian Forces Decoration. He was also mentioned in despatches.

Ontario Research Foundation Director

The Board of Governors of Ontario Research Foundation has appointed **Dr. A. D. Misener, F.R.S.C.,** to the position of Director. Dr. Misener will assume his new position upon completion of the academic year at the University of Western Ontario, where he is Professor and Head of the Department of Physics.

Re-elections and appointments at Sparton of Canada

Several year-end re-elections and new appointments of personnel at Sparton of Canada were announced by **John J. Smith,** chairman of the board, following the company's annual meeting last month.

Re-elected as officers along with Mr. Smith were **G. A. Holmes,** president, and **Burwell Graham,** vice-president in charge of engineering.

Messrs. Smith and Holmes were re-elected to the board of directors along with Harold M. Johnston and R. G. Ivey. C. V. Lyons became a new director.

Newly elected officers include Mr. Lyons, vice-president and treasurer; W. L. Page, vice-president of sales; and Kenneth R. Hollins, assistant secretary and assistant treasurer.

Mr. Lyons has been treasurer and assistant secretary since 1952. He joined Sparton of Canada in 1934 and for nine years served in the time study, payroll and purchasing departments. He was named a production manager in 1943, cost accountant in 1945 and assistant secretary and assistant treasurer in 1951.

Mr. Page started with Sparton of Canada in 1946 as western representative, became distributor sales manager in 1952 and general sales manager in 1953.

Joining the Company in 1936 as a store keeper, Mr. Hollins served in the time study, purchasing and cost departments before he was appointed office manager in 1954.

Canadian scientist honored by Oxford

The University of Oxford has awarded the honorary D.Sc. degree to **Dr. Gerhard Herzberg** of the National Research Council, Ottawa. Dr. Herzberg is director of the division of pure physics at NRC and his field of work is molecular spectroscopy. He and his group of research physicists are using various techniques of spectroscopy to investigate atoms and molecules. One aspect of this work has been the discovery of a number of new molecules in the laboratory. The investigations have led to the identification of certain compounds in interstellar space and in the atmosphere of stars and planets.

(Continued on page 50)

BATTEN

O'Hara

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Sutherland

GABY

Mansour

NAT. DEFENCE

McBurney

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in the new WL-7325 Westinghouse High Sensitivity Vidicon

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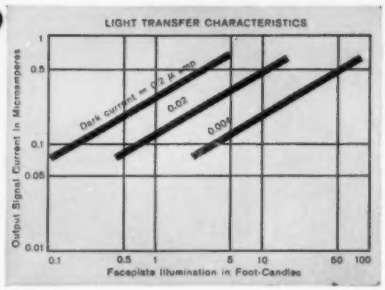

ACTUAL SIZE

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EIA requests BBG to clear way for color television

On March 14 a delegation from the Electronic Industries Association of Canada, representing the television manufacturers, presented a brief to the Board of Broadcast Governors in Toronto asking for early action to remove the two main obstacles that prevent the normal development of color television in Canada.

These obstacles were stated as:
1. The delay by the Department of Transport in approving the color television technical standards recommended for approval by all interested parties and submitted to DOT in January 1957.
2. The restrictive nature of the present licenses issued to television stations which treat color telecasting as a separate entity from black-and-white telecasting.

The EIA delegation consisted of the president, Stuart D. Brownlee, Canadian Admiral Corp. Ltd.; Ralph A. Hackbusch, Hackbusch Electronics Ltd., EIA director of engineering; R. M. Macrae, RCA Victor Co. Ltd., representing the EIA Color TV committee; and F. W. Radcliffe, EIA general manager.

The EIA brief reviewed the advances made in color television in the United States over the past few years and pointed out that there are over 500,000 color sets in use in the U. S. and two-thirds of the approximately 500 stations already have color telecasting facilities.

In reply to a question by the BBG on why there are only an estimated 1,000 color sets in operation in Canada, Brownlee said that this is because color programs can only be received in areas close to the U. S. border. These areas comprised about 10% of the potential color television market in Canada.

The brief also mentioned that modern color sets require as little servicing as black-and-white receivers and that a color table receiver could be produced in Canada to retail at a suggested list price of $695. It was stressed that the recommended engineering standards for color telecasting are based on compatibility with black-and-white transmissions.

It was also stated that the cost of converting an existing television station to re-transmit color programs available on the network was relatively low—about $24,000. This could be adopted as an interim measure to get color telecasting started in Canada until stations could originate their own color programs. Existing stations could be completely equipped for network, film, and live color programs for about $210,000.

Mr. Brownlee said that EIA had approached the CBC on the matter of color telecasting from time to time over the past few years. He also stressed that the decision to make a presentation to the BBG had been passed unanimously by both the Receiver Division of the association and its Board of Directors.

New Toronto location for CBC settled

Toronto operations of the Canadian Broadcasting Corp., which involve more than 2,000 employees now working in 14 buildings at 11 locations, are to be centralized on a 33-acre North York site.

The site has been purchased for about $650,000 and it is believed that the CBC will spend about $40 million on new buildings and facilities. Some associated industries are expected to move into the same area.

E.M.I.-Cossor keeping new plant busy

Two recent contracts should provide plenty of shop-loading for E.M.I.-Cossor Electronics Ltd. The firm moved into a new plant at Woodside, N.S., last year.

One was an urgent repeat order from Russia for six Cossor-designed ionospheric recording units worth $90,000. The other was a $2.75 million contract to make sonar equipment for the RCN. The equipment was developed initially by the Naval Research Establishment at Dartmouth and later by Cossor's engineering department.

(Continued on page 50)

Ottawa report

Revenue Minister Nowlan says he knows of no way of administering any regulation requiring mail order houses to indicate in their catalogues whether the goods they offer and advertise are specifically of foreign or domestic manufacture.

That was his reply to a suggestion in the Commons by E. A. Winkler, Conservative Grey-Bruce, that some such regulation might be desirable.

Mr. Nowlan said there were 44 varieties of goods on the list of those which must be labeled with their country of origin — a list drawn up under a cabinet order administered by the revenue minister.

Here's a handy tip from the trade department for Canadian businessmen traveling abroad:

"The businessman t r a v e l i n g abroad will often find that Canadian trade commissioners can do much to make his trip pleasant and profitable—provided that they have advance notice of the date of the visitor's arrival, his main interests and his itinerary. Too often Canadian businessmen fail to take advantage of a trade commissioner's help by dropping in on him without warning.

"If you are traveling abroad on business and think the trade commissioner might assist you, you should give early notice of your trip to the Trade Commissioner Service of the Department of Trade and Commerce in Ottawa. Give the service your itinerary and say whether you would like the trade commissioners in the countries you will visit to collect information in advance of your arrival, to arrange appointments, or to assist in other ways. If you prefer, you may write directly to these officers at their posts asking for their co-operation.

"If you are planning to initiate new business, it may be helpful to forward samples and descriptions of your products so that the trade commissioner will have a chance to make a market survey beforehand."

During his first major Commons speech this session, Prime Minister Diefenbaker very neatly and—for him—briefly summed up the real problem of C a n a d i a n defense policy these days:

"In defense, the uncertainty to which all of the free world is subject arises from the fact that it can never be finally d e t e r m i n e d whether or not the U.S.S.R. means to go to war or whether, if it does so, the war will be a nuclear one.

"Defense policy cannot be certain. If it could be certain, and if we could determine today the course for the next three or four years, great savings might be made."

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...but pay only for the time you use it.

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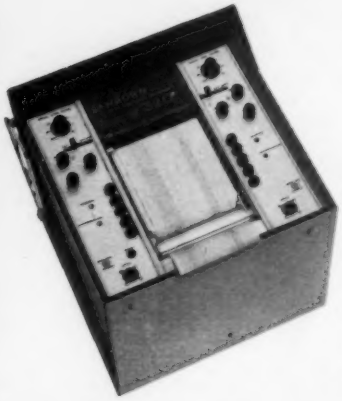
keep an accurate graphic record

OF RESEARCH, DESIGN, TEST DATA

two channels



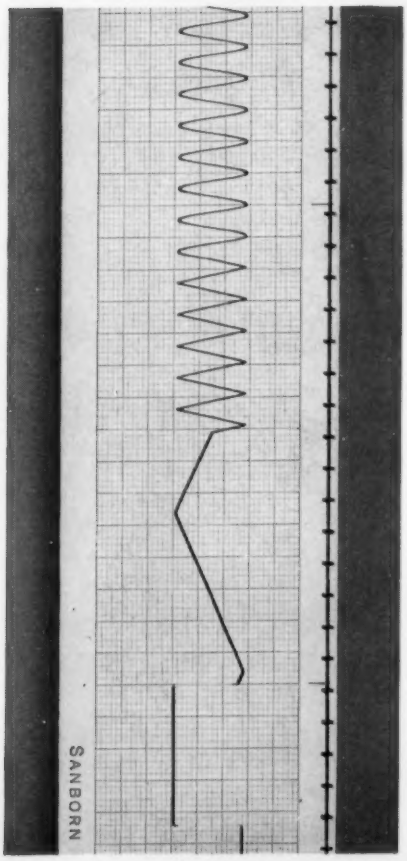
For General Purpose DC Recording — Model 320

For recording *two variables* simultaneously, the Model 320 provides a versatile, transistorized amplifier for each input signal. The rugged 2-channel recorder assembly has heated stylus recording on two *50 mm wide* rectangular coordinate channels, 4 pushbutton chart speeds, and 6 inches of visible chart. The Recorder can be placed vertically, horizontally or at a 20° angle.

MODEL 320 SPECIFICATIONS

Sensitivity: 0.5, 1, 2, 5, 10, 20 mv/mm and v/cm
Frequency Response: 3 db down at 125 cps, 10 mm peak-to-peak
Common Mode Voltage: ±500 volts max.
Common Mode Rejection: 140 db min. DC
Calibration: 10 mv internal ±1%
Output Connectors for each channel accept external monitoring 'scope or meter
Price: $1495

NEW SANBORN PORTABLE DIRECT WRITING RECORDERS FOR IN-PLANT, LABORATORY OR FIELD RECORDING



Two models of this 21 lb. brief case size recorder are available — Model 301 for AC strain gage recording, Model 299 for general purpose DC recording. Both provide immediately visible, inkless traces by heated stylus on 40 division rectangular coordinate charts . . . frequency response to 100 cps . . . 5 and 50 mm/sec chart speeds . . . approx. 4 inches of record visible in top panel window.

single channel

MODEL 301 SPECIFICATIONS

The amplifier section of the Model 301 is an all-transistorized carrier type with phase sensitive demodulator. The power supply and internal oscillator circuits are also transistorized.
Sensitivity: 10 uv rms/div (from transducer)
Attenuator Ratios: 2, 5, 10, 20, 50, 100, 200
Carrier Frequency: 2400 cps internal
Transducer Impedance: 100 ohms min.
Calibration: 40 uv/volt of excitation
Output Connector: for external monitoring 'scope or meter
Price: $750

MODEL 299 SPECIFICATIONS

Combines the dependability of transistors with the high input impedance of vacuum tubes for reliable broad-band DC recording.
Sensitivity: 10, 20, 50, 100, 200, 500 mv/div and 1, 2, 5 and 10 v/div
Input Resistance: 5 megohms balanced each side to ground
Common Mode Voltage: ±2.5 volts max. at 10 mv/div sensitivity increasing to ±500 volts max. at other sensitivities
Common Mode Rejection: 50:1 most sensitive range
Calibration: 0.2 volt internal ±1%
Output Connector: for external monitoring 'scope or meter
Price: Model 299 (with zero suppression) $700
Model 299A (without zero suppression) $650

All prices are F. O. B. Waltham, Mass., within continental U. S. A. and are subject to change without notice.

Contact your Sanborn Sales-Engineering representative for complete information, or write the main office in Waltham. Sales-Engineering representatives are located in principal cities throughout the United States, Canada and foreign countries.

SANBORN COMPANY
INDUSTRIAL DIVISION 175 Wyman Street, Waltham 54, Mass.

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The new concept of electronic equipment manufacture

A new philosophy:

Made for everyday use

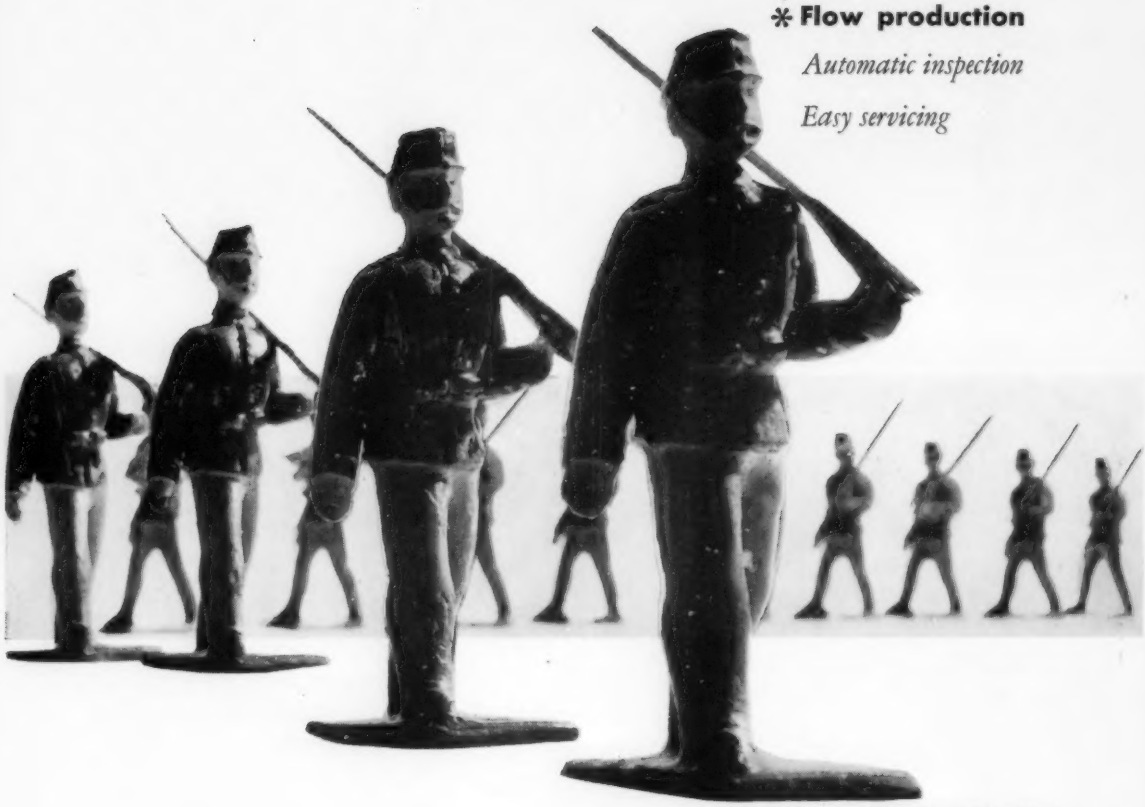
Wide range available

Modern techniques

*** Flow production**

Automatic inspection

Easy servicing



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DC-Microvoltmeter GM 6020

Measuring ranges:
A: in 11 steps from 100 μV up to 10 V full scale deflection
B: in 11 steps from 10 mV up to 1000 V full scale deflection.
Input impedance:
in range A: 1 MΩ ($\pm$ 1,5%) //15 - 20 pF
in range B: 100 MΩ ($\pm$ 1,5%) // 10 pF
Overall accuracy: 3% $\pm$ 5 μV
Deflection of pointer: always positive; polarity is indicated by 2 lamps
Mains supply: 110 . . . 245 V; 50. . . 100 c/s
5" scale with mirror reading

$345.00 Duty Included

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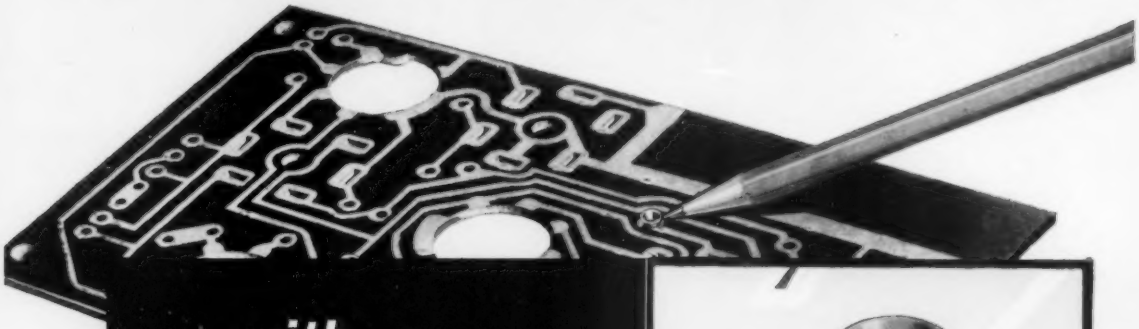
RELIABLE CONNECTIONS

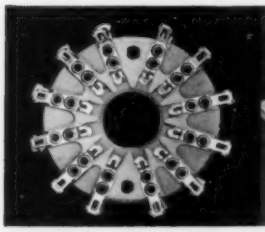


...with LOW COST EYELETS

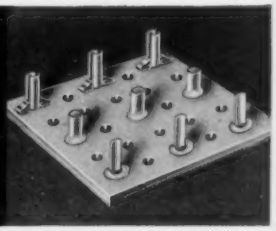
Eyelets give you unlimited opportunities for savings as connectors, fasteners, terminals, bushings, contacts for switches and hundreds of similar applications. Only with United Eyelets do you have such a wide choice of standardized sizes, special designs for cutting costs on unusual production problems, combined with a comprehensive line of the most versatile eyelet setting machines available.

In no other way can you get the flexibility obtainable with eyelets at comparable installed costs. Call or write us today for more information. Our national sales and service organization is ready to help with your most challenging problem.

NEW FUNNEL FLANGE eyelets designed especially as connectors for PW boards. Solves two-sided circuitry and solder problems. Speeds insertion. Are fed and set automatically on United Machines.



NEW MINIATURIZED EYELETS as connectors and fasteners for low cost, high speed insertion in components, PW boards, miniature equipment. Designed for high speed automatic feeding with United Machines. Copper or brass.



CUT COSTS WITH SHEARED EYELETS as stand-off terminals. Set as many as 3000 terminals per hour. Cuts soldering time too.

Simultaneous multiple eyeleting from either or both sides of machine. Typical six eyelet application illustrated. 50 years' experience is your assurance of complete dependability.

NEW EYELET SELECTOR — FREE

Simplify design, purchasing, inventory, and production. Decide the hole size and grip, and set the calculator to find the exact eyelet you need. Send for your free copy today!

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United

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OF CANADA LIMITED
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BRANCHES: TORONTO, QUEBEC CITY AND GALT

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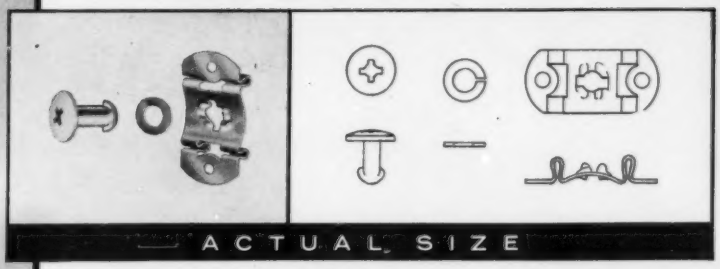
Now...

miniature

¼ turn

fasteners!



LION *miniature* FASTENERS

¼ TURN OPEN • ¼ TURN CLOSED

LIGHTWEIGHT • STRONG
MINIMUM ENVELOPE

A new size has been added to the Lion family of quick-opening fasteners . . . a miniature size. Small, compact, yet strong and rugged, these miniatures aid in reducing overall dimensions and weight without sacrificing the important advantages of larger Lion Fasteners.

ALIGNMENT NOT CRITICAL

Stud "floats" to accommodate misalignment. The hole in the sheet for the stud has an area 60% greater than the stud diameter. This allows a .030 float in all directions.

WIDE VARIATION IN STACK HEIGHT

Six different studs accommodate total material thicknesses (both sheets) of .040 minimum to .159 maximum.

Total sheet thickness served by any one stud may vary as much as .019 without affecting operation. A Lion Miniature Stud, specified for a thickness of .0863, for example, will accommodate total sheet thicknesses from .080 to .099.

SWAGED-NOSE STUD

Extra strength and smooth operation are made possible by the exclusive Lion swaged nose design. All the metal is put to work. There are no holes, thin cross pins, or milled slots to weaken the cross-section. Case hardening assures long, trouble-free service without wear.

LARGER SIZES AVAILABLE

Lion Fasteners are also available in two larger sizes—No. 5 (mil spec) and No. 2—to meet the needs of aircraft, missile and ground support equipment. The heads are supplied in a wide variety of styles including oval, flush, wing, ring, notched and knurled.

FREE!

FASTENER HANDBOOK

Send for your complete Southco Fastener Handbook, just printed.

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380 Donald Street
Winnipeg 1, Manitoba

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COMPACT, RELIABLE, VERSATILE . . .

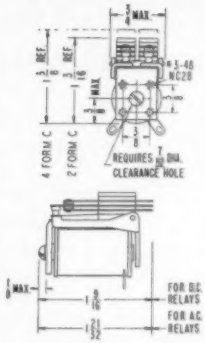
this is P&B's miniature MH relay

The MH is not a new relay.

As a matter of fact, we've been building and selling this series for seven or eight years. Its reliability and exceptional longevity have been proved in business machines, airborne computers and a host of other products.

Engineers like its fast action, its small size, its light weight. They like the wide selection of contact forms . . . up to 18 springs (9 per stack, DC) as well as the fact MH relays can be furnished to switch loads ranging from dry circuit to over 5 amps at 115 volts, 60 cycle resistive.

A multiple choice of terminations add to the MH's versatility. This relay, for example, can be adapted for printed circuits, furnished with taper tabs or a long list of other terminals. Get all the facts by calling your nearest P&B sales engineer today.



MH ENGINEERING DATA

GENERAL:

Breakdown Voltage: 500 volts RMS between all elements.

Ambient Temperatures: −45° C to +85° C. (−65° C to +125° C on special order.)

Shock: 30g on special order.

Vibration: 10g from 55 to 500 cps., .065" max. excursions from 10 to 55 cps. on special order.

Weight: 2½ ozs. max. (open relay)

Terminals: Pierced solder lugs; special lugs for printed circuits, taper tab (AMP #78).

CONTACTS:

Arrangements: Up to 9 springs per stack.

Material: ⅛" silver standard: Palladium or gold alloy also available.

Load: Dry circuits to 5 amps @ 115V AC res.

COILS:

Resistance: 22,000 ohms max.

Power: 100 mw per movable min. to 4 watts at 25° C max. (200 mw min. to meet max. shock/vibration spec.)

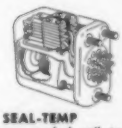
Duty: DC: Continuous. AC: Intermittent (Two pole relay max.) open. Sealed units supplied with full wave rectifier inside can.

Voltages: DC: Up to 110 volts. AC: Up to 230 volts 60 cycles.

The relays below are variations of the MH relay structure.

MA LATCHING
Electrical latch, mechanical reset. Small, versatile and offered with selection of contact arrangements.

MB CONTACTOR
Contacts rated 60 amp. 28 volts DC non-inductive. Will carry 150 amp. surge for a duration of 0.3 seconds.



MH SEAL-TEMP
Features sealed coil to minimize contact contamination. Available as hermetically sealed relay only.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD CANADA LTD.

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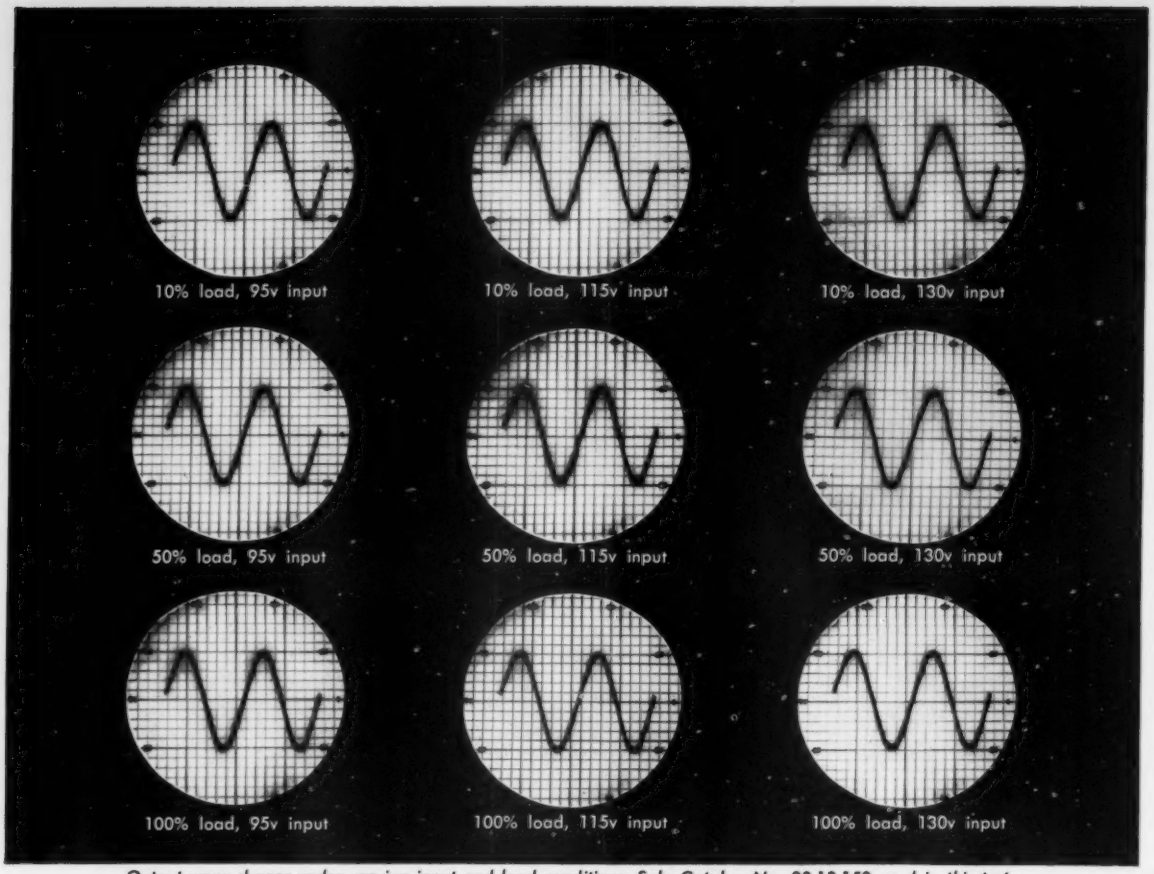
10% load, 95v input
10% load, 115v input
10% load, 130v input
50% load, 95v input
50% load, 115v input
50% load, 130v input
100% load, 95v input
100% load, 115v input
100% load, 130v input

Output wave shapes under varying input and load conditions. Sola Catalog No. 23-13-150 used in this test.

Sola's moderate-cost static-magnetic voltage regulator has sine-wave output

Sola now offers sinusoidal output in every standard-type regulator *with no price premium*. This development — a result of major design and production innovations — greatly widens the field of use for static-magnetic voltage regulation. The new standard sinusoidal design is now ideal for use with electrical and electronic equipment requiring a regulated input voltage with commercial sine wave shape — especially where harmonic-free supply had previously been too costly. The sinusoidal output also contributes to ease of selection and ordering, since this Sola stabilizer is virtually universal in application.

The Sola Standard Sinusoidal Constant Voltage Transformer provides output with less than 3% rms harmonic content. It automatically and continuously regulates output voltage within ±1% for line voltage variations of ±15%. Average response time is 1.5 cycles or less. The new line includes nine stock output ratings from 60va to 7500va.

Besides the improved electrical characteristics, these units are substantially smaller and lighter than previous models. Size and weight reductions were accomplished without any loss of performance or dependability.

With the Sola Standard Sinusoidal Constant Voltage Transformer you also get all the proved benefits of a static-magnetic regulator. It is simple and rugged. There are no tubes . . . no moving parts . . . no replaceable parts. Maintenance and manual adjustment are not necessary.

Its current-limiting characteristic protects against shorts on the load circuit. It is available in step-up and step-down ratios, allowing substitution for conventional, non-regulating transformers. These units can be used in any electronic or electrical application requiring a regulated sinusoidal power source where the peak power demand does not exceed the capacity of the constant voltage transformer. Circuit design formulae based on sinusoidal wave shape are directly applicable. Custom units to specific requirements are available in production quantities.

Write for Bulletin CVS

SOLA

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FEDERAL PUTS A TWIST IN TELEPHONE CABLE

Special 'Unilay' Construction

Twist it's open . . . twist it's closed! Just as simple as that, this one-direction cabling technique gives easy access to inner conductors . . . makes possible faster, more efficient mid-span taps.

A feature in . . .
FEDERAL TYPE B RURAL DISTRIBUTION WIRE

Because of its high tensile strength, it is ideal where longer spans are required. Its rugged construction gives excellent service life and permits re-use after emergency operation. Thus, considerable time and expense are saved in new construction. Engineered for maximum dielectric strength, low transmission loss and cross talk, Federal Rural Distribution Wire provides the best in subscriber service at minimum cost.

Another fine product . . .
FEDERAL TYPE NC TELEPHONE DROP WIRE

is specially built for life-long resistance to severe wind and ice-loading conditions. Its high dielectric rubber insulation is securely bonded to No. 18 copperweld conductors. The tough, reinforced neoprene sheath is ribbed for quick polarity identification by touch. It comes in solidly taped 1,000 foot "Tangle-proof" coils for fast, efficient installation. Buy Federal quality for dependable service.

FEDERAL WIRE PORTER ***& CABLE DIVISION***

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RESISTORS

THE EXACT RESISTOR YOU NEED—WHEN YOU NEED IT—FOR EVERY INDUSTRIAL AND MILITARY REQUIREMENT

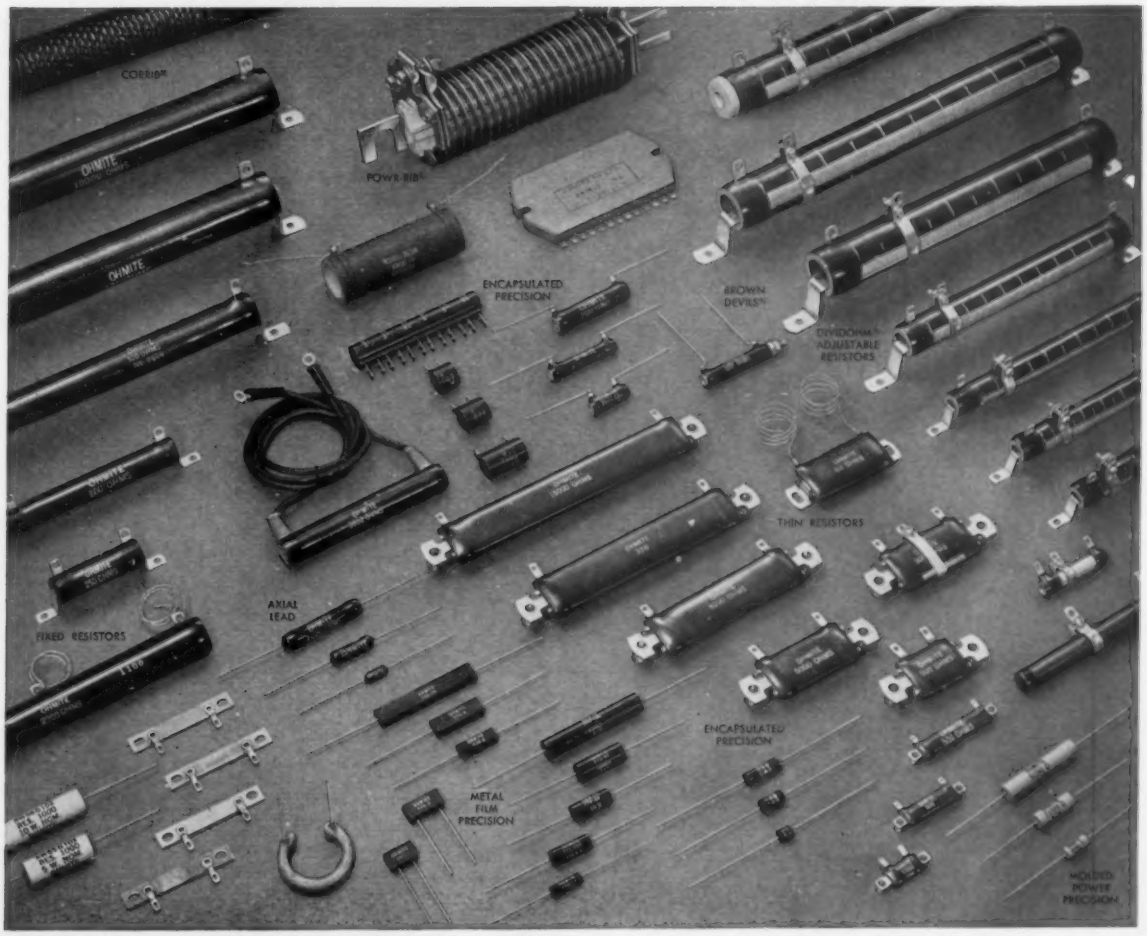
Fixed . . . adjustable . . . tapped . . . noninductive . . . precision metal film and encapsulated wire-wound . . . thin type . . . high-current—practically any resistor you need, you can find in the Ohmite line.

WORLD'S LARGEST STOCK FOR IMMEDIATE DELIVERY—Chances are Ohmite's huge stock of several million resistors in more than 2000 sizes and types contains a unit that fits your requirements. Many types are also available through Electronic Parts Distributors located across the Nation.

YOUR CUSTOMERS KNOW THE VALUE OF OHMITE QUALITY—When a purchaser sees Ohmite resistors in a piece of equipment, he knows that equipment is designed and built for dependability.

OHMITE ENGINEERING ASSISTANCE ASSURES THE RIGHT UNIT—Selecting the right resistor for the job is sometimes a tough problem. Why not call on Ohmite application engineers to help out. Take advantage of their specialized skills and background.

Write on Company Letterhead for Catalog and Engineering Manual 58



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Quality Components

RHEOSTATS • RESISTORS • TAP SWITCHES
RELAYS • R.F. CHOKES • TANTALUM CAPACITORS
VARIABLE TRANSFORMERS • GERMANIUM DIODES

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3623 Howard Street, Skokie, Illinois

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"Where can flame-retardance improve your product; make it safer . . . function better . . . or sell faster?"

Choose from 11 National Materials—in sheets, tubes, rods, formed shapes, or precision-fabricated parts

Computers, high-voltage switchgear, home appliances, television receivers, radios and radar . . . aircraft and missile instrumentation . . . in fact, with any product where fire is a potential, flame-retardant laminates pay-off in design features and product protection.

The "pay-off" comes in protection of lives and expensive equipment from fire, because these materials are self-extinguishing. As barriers, base plates, terminal boards, support members, printed circuits—National's family of flame-retardant materials is solving problems of fire containment and those involving *both* fire and electrical insulation.

Surprisingly, *low cost* is a feature of several of these materials. And since they mean more safety and product protection for the user, the "pay-off" also comes in the form of added product sales features.

Grade	Base	Resin	Extinguishing Time (sec.) UL
PYRONIL	Cellulose	None	<1
X-121	Paper	Phenolic	2-4
X-122	Paper	Phenolic	1
XX-326	Paper	Phenolic	1½-2
XXXP-475	Paper	Phenolic	<1-1½
GP-9202	Glass Mat	Polyester	<1
GP-9204	Glass Mat	Polyester	<1
G-5-813	Glass Cloth	Melamine	<1
G-7-832	Glass Cloth	Silicone	<1
GH-871	Glass Cloth	Phenolic	<1
EP-491	Paper	Epoxy	<1

NATIONAL

FIBRE COMPANY OF CANADA, LTD.
ATLANTIC & HANNA AVENUES • TORONTO
1411 CRESCENT STREET • MONTREAL
ADDRESS DEPT. FF-4

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Clip and file this reference sheet for future use

ROGERS

REFERENCE BULLETIN NO. 4

EC157 Disk Sealed Triode guaranteed for 6000 hours

The EC157 triode serves as an amplifier tube in beam transmitter relay stations for the transmission of TV and telephony link broadband signals at 4000 mc/s. Station breakdowns in microwave communications are costly in time and money. The EC157, with a *guaranteed life of 6000 hours*, assures against early breakdowns, saves time and money. Its longer life means a more reasonable operating cost – *not more than 2.3¢ per hour of service.*

The EC157 triodes offer many desirable features – peak performance, dependable service and outstanding uniformity from tube to tube.

TECHNICAL DATA

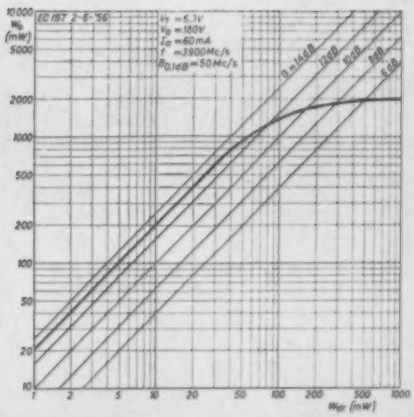
HEATER	V_h = 6.3 V					
	I_h = 0.73 A					
TYPICAL CHARACTERISTICS		nom.	min.	max.	nom.	
Anode voltage	V_a =	180	–	–	180	V
Anode current	I_a =	30	–	–	60	mA
Grid voltage	V_g =	-2.8	-4.0	-1.8	-1.6	V
Mutual conductance	S =	17	13.5	–	19	mA/V
Amplification factor	μ =	43	33	52	43	

OPERATING CONDITIONS AS GROUNDED GRID AMPLIFIER AT 4000 Mc/s

Anode supply voltage	V_{ba} =	200 V
Grid supply voltage	V_{bg} =	+20 V
Cathode bias resistor	R_k =	max. 500 Ω
Anode current	I_a =	60 mA
Bandwidth (0.1 dB down)	B =	50 Mc/s
Output power at 8 dB power gain (V_f = 6.3 V)	W_o =	1.8 W (min. 1.5 W)

MAXIMUM RATINGS (absolute maxima)

Anode voltage at zero anode current	V_{ao} =	500 V
Anode voltage	V_a =	300 V
Anode dissipation	W_a =	10 W
Cathode current	I_k =	70 mA
Grid current	I_g =	10 mA
Driving power (grounded grid)	W_{dr} =	1 W
Direct grid voltage (positive)	V_g =	0 V
Direct grid voltage (negative)	V_g =	-50 V
Heater to cathode voltage	V_{kf} =	50 V
External resistance between cathode and heater	R_{kf} =	20 kΩ
External resistance between grid and cathode	R_{gk} =	25 kΩ
Anode seal temperature	t_a =	150 °C
Grid seal temperature	t_g =	75 °C
Cathode seal temperature	t_k =	75 °C



Output power (W_o) of the EC157 as a function of the driving power (W_{dr}) with lines of constant power gain (G); (f = 3900 Mc/s. $B_{0.1\ dB}$ = 50 Mc/s, V_a = 180 V, I_a = 60 mA).

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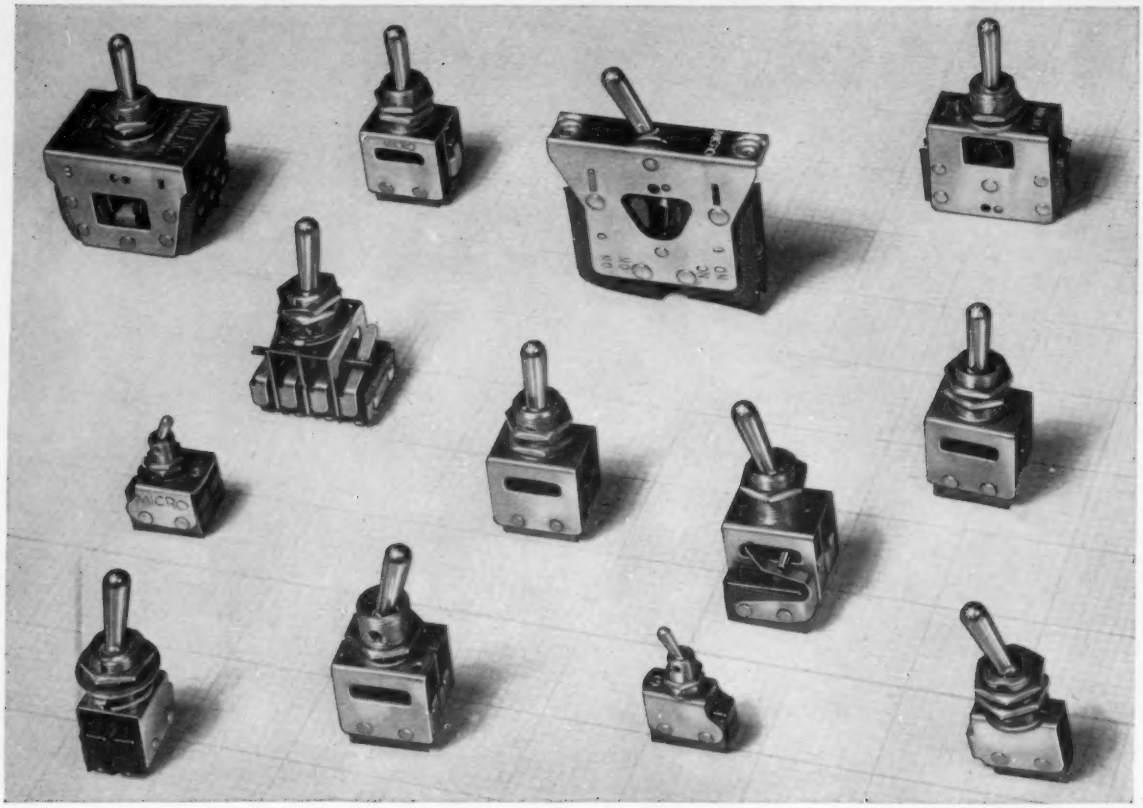

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The 13 toggle switch assemblies illustrated above represent a group of more than 100 similar compact assemblies designed to actuate from one to as many as a dozen miniature precision basic switching units. They find wide use in aircraft, mobile, marine, electronic, and all panel applications.

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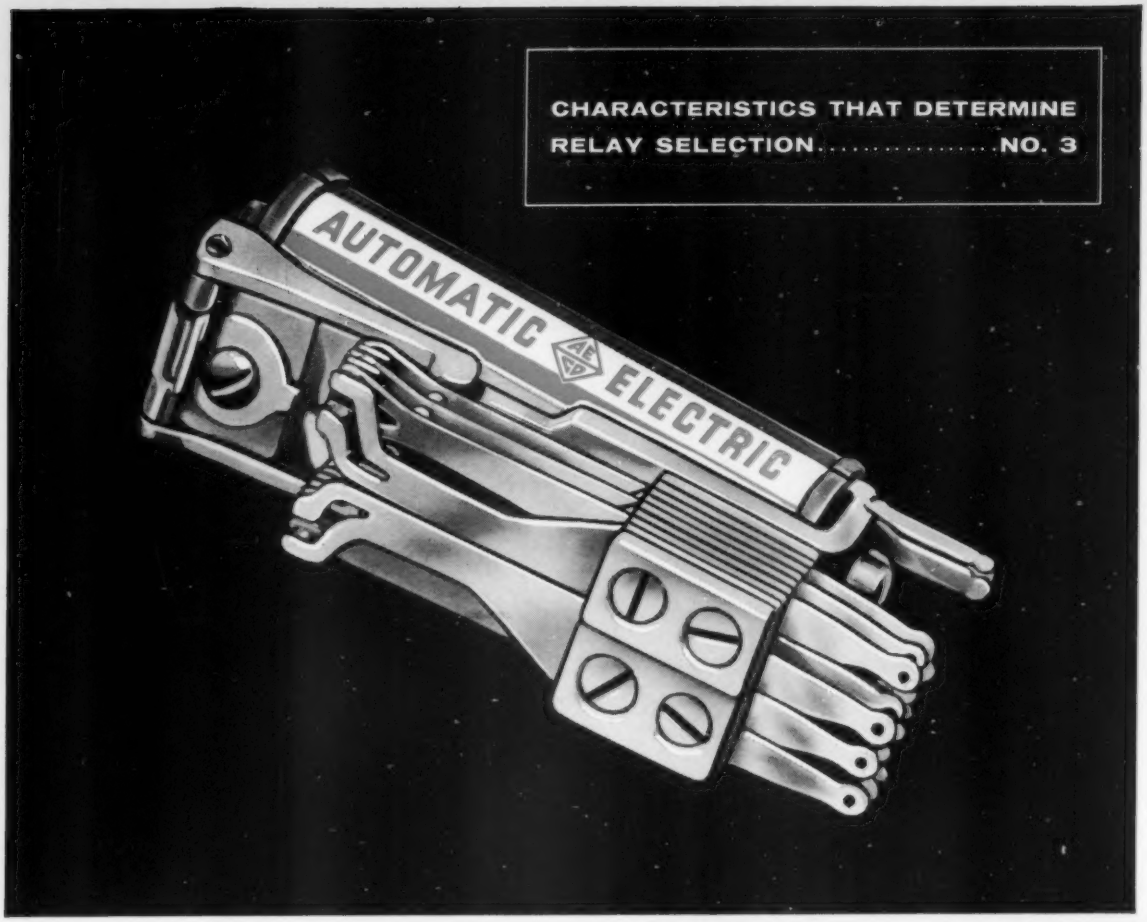

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Are we wasting money on air defence?

Canadians are gravely concerned about defense—the amount of money they are spending for it, the amount of defense they are getting for that expenditure. Many questions are being asked, in the House of Commons, in our national press, and in the country at large, about the exact nature of our defense program and the policy on which the program is based.

And this is not surprising when one considers the sequence of events that includes the cancellation of the CF-100 Mark 6; the cancellation of the CF-105 and adoption of Bomarc and the CADIN extensions of the SAGE system; the planned withdrawal from duty in the Atlantic and Pacific oceans of nearly all of the U. S. Navy radar picket ships; and the recently announced decision to continue with the construction of Bomarc bases despite drastic cut-backs in the U. S. Bomarc program.

The Minister of National Defence has said that the U.S.S.R. still has a number of manned bombers in service despite the new emphasis on ICBM's. In the event of attack, he claimed, it would probably use the bombers against large centres of population and the missiles against strategic targets. This is given as the reason Canada and the United States are concentrating their anti-bomber defenses in the heavily-populated eastern areas of the two countries. But are we justified in continuing to spend $125 million on the installation of two Bomarc squadrons in Canada to meet a threat that many experts believe will never materialize?

Canada's electronics industry, in common with other industries whose products are vital to defense, have been asked to "get out and sell" to ensure their participation in the U. S.-Canadian Integrated Defence Production Program. Particularly in electronics, where the technology is advancing so rapidly, they have also been told that emphasis on research and development will further ensure getting a proper share of the orders.

We suggest that a complete examination of our over-all defense policy and program may well reveal areas from which funds could be diverted to greater support of industry's efforts. This would not only help to secure the immediate future of thousands of Canada's working population; intensified R and D activity would also lead to better commercial products that Canada could sell in world markets.

Let us examine our defense policy, not only in relation to immediate and projected strategic and political considerations, but also in relation to Canada's future as a trading nation.

THE EDITOR

Co-author Paul Webb holds sample of the alpha-particle detector against a background of nucleonic test equipment.

Silicon junction devices detect nuclear particles

R. W. JACKSON, MEM.IRE and P. P. WEBB, MEM.IRE.*

Scientists at RCA Victor Co. Ltd., Montreal, have developed a solid state device capable of detecting radiation particles. It is 8 to 10 times more sensitive than gas-filled ionization chambers and does not require a window. These, and other features will open new channels in nuclear research

*Research Laboratories, RCA Victor Co. Ltd., Montreal.

The latest addition to the growing family of solid state devices that began with the transistor is a device which may revolutionize many of the techniques in nuclear physics for the detection and measurement of radioactive particles. The new silicon junction nuclear particle detector is what amounts to a "solid state ionization chamber" formed just below the surface of a slice of high quality single crystal silicon by the depletion layer of a large area pn junction. The junction is formed by diffusing n-type impurity a little way into the surface of p-type silicon to create an n-layer only a few tenths to a few microns thick. The electric field at the junction due to the diffusion potential, usually enhanced by an externally applied bias, sweeps out any free current carriers from a layer anywhere from 10 to 500 or so microns in depth, depending on the purity of the p-type bulk material. A high-energy charged particle ploughing into this region loses its energy and is brought to a stop by colliding with the atoms of the crystal, exciting free electrons (and holes) as it does so. The free charge carriers thus released are quickly swept out by the field, to show as a current pulse in the external circuit.

One fact which gives the solid state device notable advantages over the gas-filled ionization chamber which has been used up to now is that the ionization energy for an atom is a factor of 8 or 10 lower in the solid than in the gaseous state. Thus, for a given energy of impinging particle, 8 or 10 times as much ionization is generated in the solid state detector relative to the gaseous. The increased sensitivity and improved energy resolution which this makes possible are resulting in new research results which were unobtainable before. Another advantage follows from the elimination of the thin fragile window which was necessary in the gaseous ionization chamber. By making the n-layer very thin on the junction detector, ionization can reach the depletion layer even from heavy par-

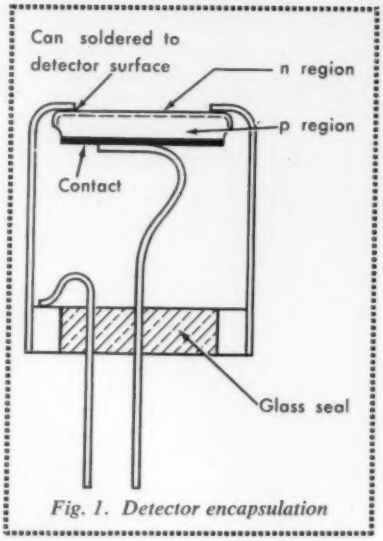

Fig. 1. Detector encapsulation

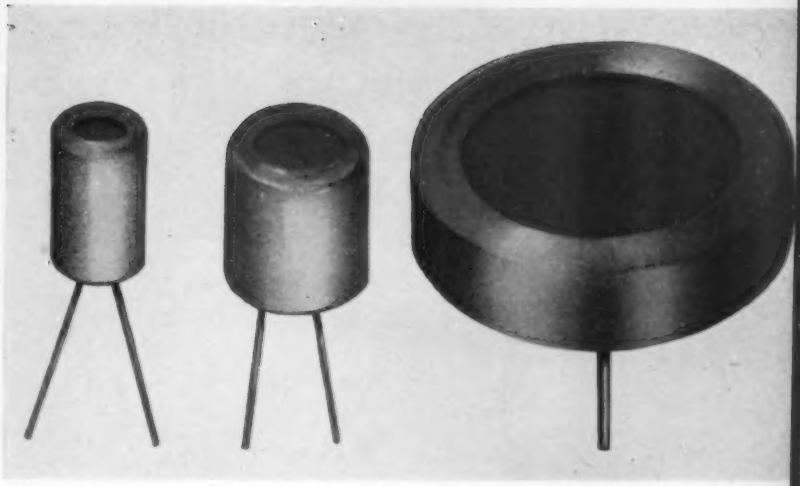

Fig. 2. Completed units in sizes 5 sq mm, 20 sq mm, and 200 sq mm

ticles, such as fission fragments, which barely penetrate the surface. This "windowless" feature is exciting great interest wherever nuclear physicists and engineers are interested in reactions involving heavy ions, which is almost everywhere that nuclear research is being done these days. Another advantage of the junction detector is the very fast rise of the pulse which is generated, the pulse rise time being of the order of 10^{-8} seconds in silicon, and still shorter in materials with higher carrier mobilities.

Devices are rugged and small

However, the advantages of the solid state particle detector are not only in respects which are of interest to research workers. The devices are naturally rugged and small and, where only the counting of particles is required without regard to their energy, they may be operated with only a few volts biast or no bias at all—quite different from Geiger counters, scintillation counters and the like, which require biases of hundreds of volts. Thus these devices are ideal for portable use, and for many instances of reliable instrumentation, e.g. the monitoring of hands, feet clothing, and other surfaces for alpha-radioactive contamination, and the monitoring for alpha-activity of effluent gases and liquids from atomic reactors.

It was obvious very early to those working on semiconductors that a pn junction, just as it is sensitive to light, should be sensitive to ionizing radiation, and McKay of Bell Telephone Laboratories published in 1951 a paper reporting the detection of alpha-particles by a pn junction and giving measured figures for the average energy loss of an alpha-particle for each electron-hole pair formed in germanium and silicon. However, all the implications of this discovery as far as nuclear physics was concerned apparently did not sink in at the time and it is only recently that interest in these devices has caught fire. Some of the leading work in fabricating detectors of useful configuration and measuring their properties has been done by Drs. McKenzie and Bromley of Chalk River, and it was in close association with Dr. McKenzie that the improved diffused-silicon encapsulated version of the device was developed at the RCA Victor Research Laboratories in Montreal. (The work has been supported in large part by a contract from the Electron Devices Research & Development Committee of the Defence Research Board, Ottawa).

Some of the best results in high resolution with junction detectors have been obtained recently by Blankenship and co-workers at Oak Ridge. Other contributors to the field have been Mayer & Gossick (Purdue 1956), Walter, Dabbs, et al (Oak Ridge, 1958), Miller (Brookhaven) and Friedland, Mayer & Wiggins (Hughes Semiconductors). Russian physicists have also been very active.

Some work done with germanium

Most of the work referred to above was done for the primary purpose of obtaining experimental results and the junctions were fabricated in various ways without regard to their long-term survival or for their suitability for a variety of uses. Some of the work was done with germanium as the semiconductor material, requiring the device to be cooled in liquid nitrogen to reduce the thermally generated reverse current to low enough values to obtain good sensitivity and resolution. The RCA Victor work concentrated on silicon as the basic material since its higher energy gap makes feasible devices which work at room temperature, and concentrated on developing a configuration which would provide a good geometry for general use and which would preserve the characteristics from deterioration with time. The result is shown in fig. 1. The "window" to the sensitive region is right at the front of the

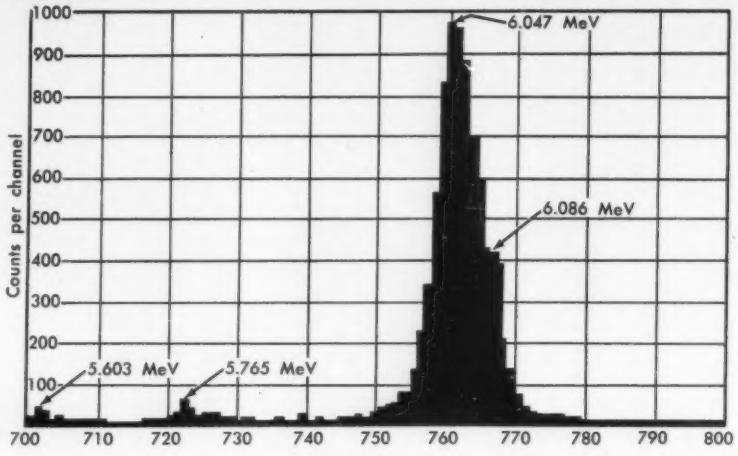

Fig. 3. Alpha spectrum from Bismuth 212, showing energy resolution of 0.7% at 6 MeV, using detector Type A with 34 v bias

device, allowing it to be used close up to radio-active sources and, in fact, allowing materials to be painted directly on the window. An application for this technique is the detection of slow neutrons by the detection of fission products from a thin layer of fissionable uranium painted on the window. At the same time the junction edge is safely maintained in a clean undisturbed environment inside the can. The can is similar to the standard transistor encapsulation. Devices in this configuration have been made with sensitive areas from 5 mm² to 2 cm². Three types are shown in the photograph fig. 2.

The performance of typical units as proportional counters is shown in fig. 3 and 4. Fig. 3 shows the energy spectrum of alpha particles from Bismuth^{212}, one of the atoms in the Thorium chain of radioactive decay. The spectrum was obtained using the Chalk River 100-channel pulse height analyzing equipment. Fig. 4 shows how the proportionality curve (a straight line) of pulse height against alpha-particle energy extrapolates very nearly through zero, implying a very thin "dead layer."

Many possible uses

The uses of the silicon junction alpha detector are many and it is exciting great interest throughout the nuclear physics and atomic energy fields. The single device, for instance, is just the first step toward constructing matrices of tens to hundreds of square centimeters in area for contamination monitoring in atomic energy establishments. Because of its small size, ruggedness, and low voltage requirements, the silicon junction particle detector is ideal for portable use and for sending aloft in satellites to measure the heavy-particle radiation outside the earth's atmosphere. In order to keep things in proper perspective, however, it may be worth pointing out that these detectors are not yet the answer to the civil defence warden's dreams since the fallout with which he is chiefly concerned gives off principally beta and gamma rays, to which these detectors so far are vitally insensitive. There may, of course, still be a call for the alpha-detector to pinpoint the location of alpha-emitting contamination such as unfissioned uranium scattered from an exploded bomb.

Continuing research, however, will probably show that the silicon junction alpha-detector is only the first in a series of new devices which will include new solid state devices for the detection of beta and gamma radiation. The crystal scintillation detectors at present in wide use for beta and gamma detection are themselves solid state devices of another type after all, reinforcing the expectation that there may be a number of members yet to come before the family is complete. END

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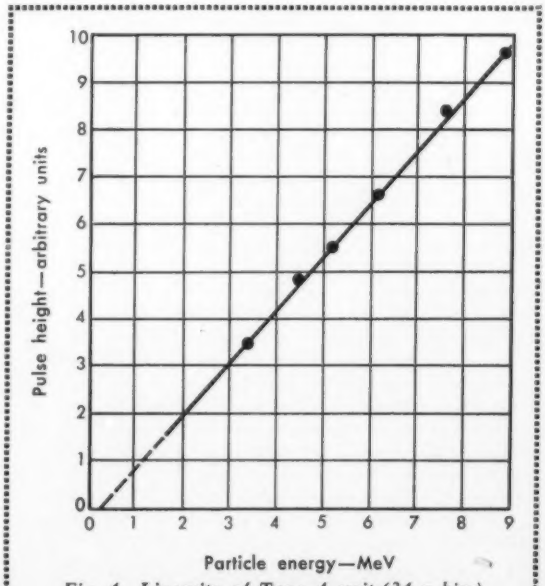

Fig. 4. Linearity of Type A unit (34 v bias) —pulse height vs. energy of alpha particle

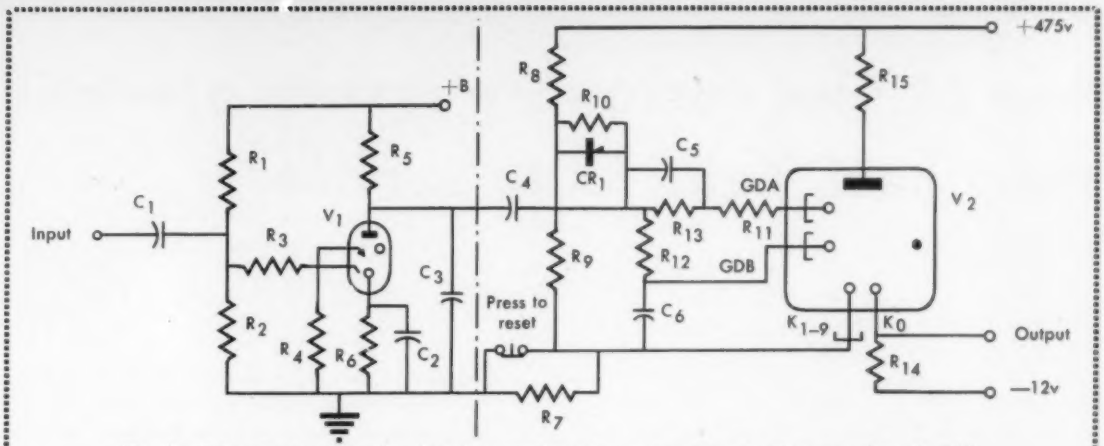

Fig. 1. Trigger tube drive for decade counting tube — component values are given in table.

Cold cathode tube drives decade counter

P. G. HODGSON*

An inexpensive cold cathode trigger tube drive circuit for a decade counting tube is described. The maximum counting rate is 2500 pps compared with 4000 pps using more expensive thermionic drives. Some of the advantages of cold cathode operation are discussed

One of the most important advantages of the decade counting tube is the compact physical size for a given storage unit. Furthermore, no separate read-out device is necessary since the position of the count can be seen through the end of the tube as a glow-discharge. For counting speeds up to 20 kc the cold-cathode counting tube is inexpensive, reliable and has a long life.

These tubes are usually driven by thermionic tubes, which in some respects detracts from the advantages of cold-cathode operation. With some sacrifice in operating speed, cold-cathode trigger tubes may be used to drive decade counting tubes, with the following advantages:

(a) They are inexpensive compared with most thermionic tubes.
(b) Since there are no heaters, no warm-up time is required for the unit.
(c) Heat dissipation is not usually a problem since power consumption is low. Each decade uses approximately 1 watt.
(d) Trigger tubes are rugged and have a long life.[1]

Operation

The operation of the circuit will be described with reference to Fig. 1. Circuits using the Z7OU, Z5OT and the XC23 are all similar in operation but the respective maximum operating speeds are 2500 pps, 1500 pps and 350 pps respectively. The Z5OT and the XC23 must be exposed to some light or erratic operation may result.

The maximum reliable operating speed recommended by the manufacturer is 1000 pps for the Z5OT trigger tube. However, the tubes available achieved or surpassed this speed.

*National Research Council, Radio and Electrical Engineering Division, Ottawa.

A positive pulse of sufficient amplitude and duration on the trigger tube starter electrode causes the tube to conduct, discharging C_3 rapidly. When the current through the tube decreases to some minimum value, the tube extinguishes, allowing C_3 to recharge through R_3.

The resulting negative pulse is shaped by networks R_{11}, C_5 and R_{12}, R_{13}, C_6 before being applied to the "A" and "B" guides of the decade counting tube. This decade counting tube, V_2, then operates in a manner described by Bacon and Pollard[2] such that the glow discharge is transferred from one cathode to the next at each triggering pulse. A "carry" pulse is passed to the next decade when the glow-discharge arrives at cathode K_0. END

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	Philips	Philips	Hivac		Mullard
VI	Z 70 U	Z 50 T	XC 23	V2	Z 502 S
+B	320 V	160 V	190 V	C4	2200 pf
C1	150 pf	180 pf	180 pf	C5	2200 pf
C2	.05 uf	.05 uf	.05 uf	C6	120 pf
C3	1500 pf	1500 pf	.01 uf	CR1	1N2071
R1	2.2 M	1.8 M	1.8 M	R7	100 k
R2	1.5 M	1 M	820 k	R8	220 k lw
R3	12 k	12 k	12 k	R9	15 k
R4	10 M	Not used	Not used	R10	1.8 M
R5	470 k	390 k	390 k	R11	33 k
R6	1 k	1 k	1 k	R12	82 k
Max. PRF	2500 cps	1500 cps	350 cps	R13	560 k
Min. input pulse amplitude: 30 V				R14	120 k
Min. input pulse duration: 20 usec				R15	820 k

All resistors ½ w ± 10% unless otherwise stated

New 11 kmc microwave system provides short haul, light route service

J. E. A. YEATS, P. ENG.*

The type TJ microwave system has been developed for such applications as spur routes from transcontinental or existing toll line facilities. Operating at 10.7 to 11.7 kmc, each of its six radio channels can carry one tv program or up to 240 channels of suppressed carrier. This article gives a general description of all aspects of the system

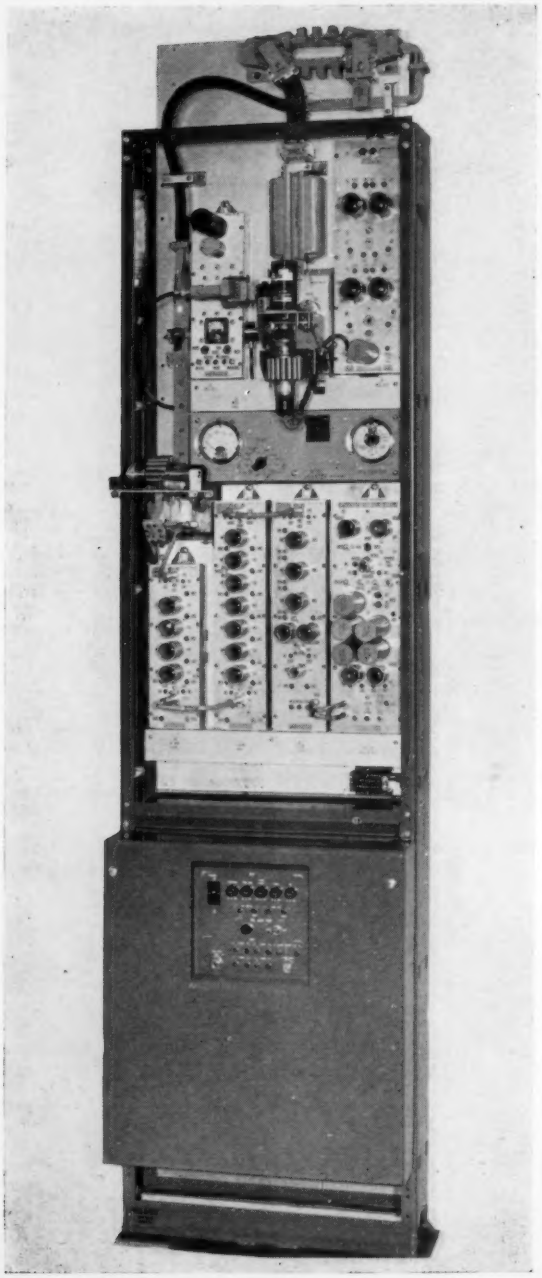

Fig. 1. Transmitter-receiver bay with covers removed from klystrons

A new microwave system has been developed by the Bell Telephone Laboratories for short haul, light route service. Coded type TJ, it is intended for such applications as spur routes from transcontinental or existing toll line facilities.

TJ radio is designed to operate in the rf range between 10.7 and 11.7 kmc for distances up to approximately 300 miles with repeater stations spaced about 15 to 30 miles apart. The choice of radio frequencies in this region avoids interference with systems in other more extensively used common carrier bands while providing compatibility among TD2[1], TJ and the future TH[2] Bell systems.

Factors affecting propagation at 11 kmc differ somewhat from those prevailing at lower frequencies, with consequent influence on system design. Some aspects of propagation are outlined in a later section.

General description

The ac-operated TJ radio system comprises six radio channels in each direction of transmission. Each channel is capable of handling one color or monochrome television channel, 96 channels of transmitted carrier or 240 channels of suppressed carrier. Route lengths may vary from about 100 miles for tv up to 300 miles for message. The actual system length, circuit capacity and repeater spacing are all variable and depend upon many factors including noise objectives, fading and rainfall attenuation.

For increased reliability radio channels may be operated on a one-for-one protection basis with frequency diversity switching over each repeater section.

At each repeater signals are reduced to base-band to facilitate dropping and inserting of channels. This arrangement, which utilizes the same design for repeater and terminal equipment, permits the order wire and alarm information to be transmitted over the radio system.

A single antenna is used to transmit and receive the six rf channels of a fully loaded system. Signals are fed to a dual polarized antenna which is customarily used in conjunction with a reflector so as to minimize waveguide loss.

Propagation at 11 kmc

Although the problem of fading is complex, data gathered over a long period of time has yielded some indi-

*Northern Electric Company Limited, Montreal.

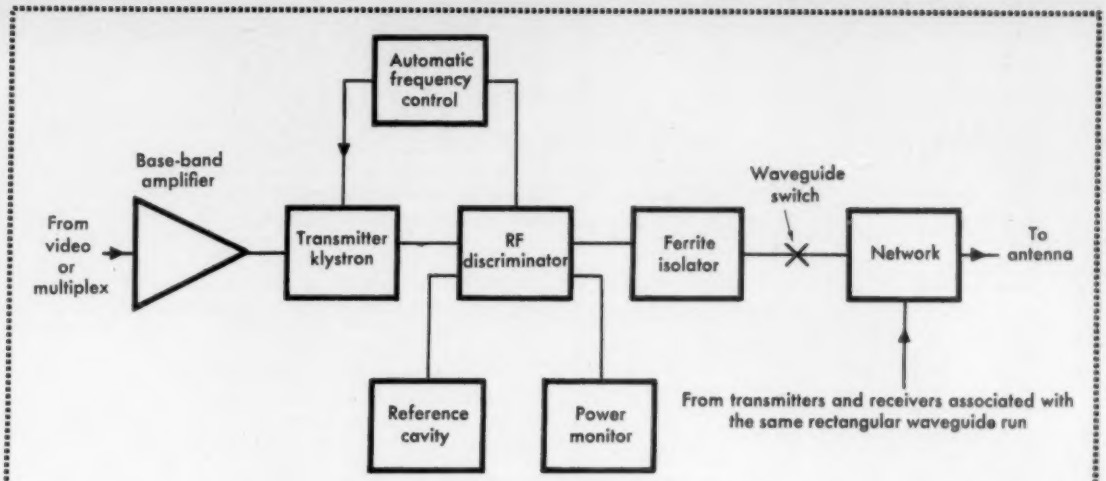

Fig. 2. Transmitter block schematic diagram

cation of its effect on certain parameters. Briefly, the number of fades during a given time increases with path length and radio frequency but the duration of a single fade is correspondingly shorter. Similar trends in the 11 kmc region are supported by field measurements conducted by Bell Telephone Laboratories[8], and it would appear that the total outage during deep fades is similar for 11 kmc and 4 kmc.

Also to be considered at TJ frequencies is the loss of energy by rainfall absorption and scattering. These effects increase as the microwave wavelength approaches the rain droplet diameter, the amount of attenuation being dependent upon droplet size, depth of rainstorm and rate of precipitation. System outage is expected to be confined to short periods during heavy rainfall. It should not significantly limit the design objectives of a particular route, except in areas where the incidence of thunderstorms is high such as the Gulf States of the U. S. A.

Frequency plan

The total rf band of 1,000 mc is divided into 24 channels each about 40 mc in width, with alternate channels arranged in two groups of 12. Each repeater section utilizes one group only and alternate sections are assigned separate frequencies. In one repeater section all transmitters are allocated frequencies in the upper half of the spectrum with receivers occupying the other half. In adjacent sections the assignment is inverted.

Recurring frequencies along a route are oppositely polarized so as to reduce the risk of over-reach interference. Co-channel interference is avoided by employment of the four-frequency allocation.

In any path the minimum spacing between two channels in the same direction of transmission is 80 mc with opposite polarization. Channels of a diversity pair are separated by 240 mc and are also oppositely polarized.

Equipment arrangement

Two types of equipment bays are required for the TJ system: transmitter-receiver and auxiliary. The radio equipment used at terminals and repeaters is identical except for frequency-sensitive components.

The transmitter-receiver 6½-ft duct type bay (fig. 1) includes the radio equipment and associated ac power supply for one rf channel. Most subassemblies are of the plug-in type and are located on shock-mounted aluminum plates. Bay design permits servicing from the front with attendant flexibility of floor plan arrangements.

The 7-ft duct type order wire, alarm and control bay houses up to six diversity switch and transmission units (the complement of a fully equipped repeater point), an alarm unit, and rectifiers for use when an office battery is not available.

Transmitter operation

The transmitter (fig. 2) incorporates three principal subassemblies: base-band amplifier, transmitter and afc unit.

The base-band amplifier accepts either 124 ohms balanced or 75 ohms unbalanced signals at a level of —18 dbv (⅛-volt peak-to-peak). A gain of approximately 37.5 db is provided by two balanced stages with a gain-frequency response of ±0.1 db between 60 cps and 6 mc. The maximum output delivered to the transmitter is +20 dbv.

A nominal rf output of ½ watt is obtained from a reflex klystron which is frequency modulated by application of the base-band output signal to the repeller. A sample of the output energy is fed through a 24-db directional coupler and its frequency compared with that from an invar cavity reference. Deviation from the required frequency produces an error signal in an afc circuit which causes a servomotor to adjust the tuning diaphragm of the klystron cavity. Transmitter linearity and frequency stability are better than 2% and ±0.05% respectively.

In the transmission path beyond the afc network, a ferrite isolator presents a stable load impedance to the tube regardless of impedance irregularities in the waveguide and antenna. Transmission loss is less than 1 db in the forward direction but greater than 55 db in reverse, throughout the rf band of 10.7 to 11.7 kmc. The presence of an isolator prevents klystron "pulling" or deviation from its oscillating frequency and also permits a greater latitude in antenna return loss.

A waveguide switch terminates the transmitter to avoid interference in the rf band when the transmitter klystron is being adjusted. Before passing to the antenna system a network combines signals from other transmitters and receivers associated with the same rectangular waveguide run.

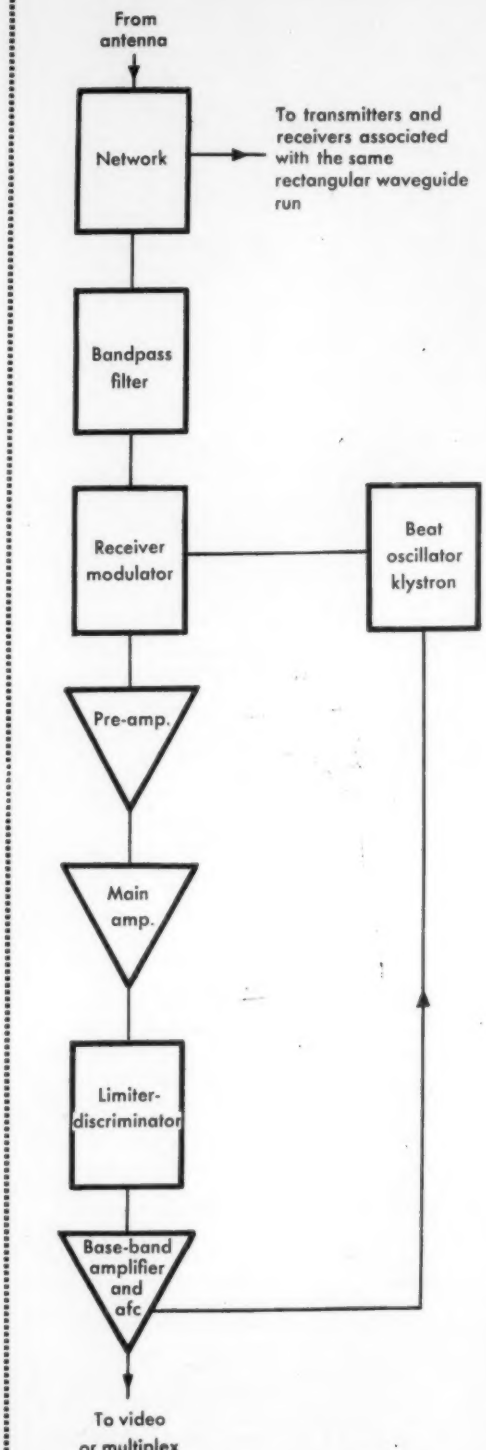

Fig. 3. Receiver block schematic diagram

The rf bandwidth is 20 mc and transmitter frequency deviation ± 4 mc. The overall base-band response of the transmitter is ± 0.2 db from 60 cps to 6 mc.

Receiver operation

After selection by a channel separation network, signals pass through a bandpass filter to a balanced crystal converter or mixer where they are combined with the output of a local oscillator (fig. 3). This is a klystron of the same type as that used in the transmitter, operated at lower potentials for an output of about 50 milliwatts. Unlike the mechanically-tuned transmitter klystron its frequency is controlled by variation of the repeller voltage. Mixing of the signal and local oscillator frequencies produces an i-f band about 20 mc wide centred at 70 mc. The receiver noise figure is 15 db.

Two i-f amplifiers raise the received signal power to +5 dbm over the 60-80 mc band, the gain-frequency response being flat to within ± 0.5 db. The pre-amplifier has a low noise cascode input and provides a fixed gain of 32 db. The main amplifier comprises 7 stages for a gain of 75 db maximum with automatic gain control.

Amplitude variations of the received signal are removed in a three-stage limiter using varistor networks for the clipping action. In the discriminator two antiresonant circuits are tuned to 60 and 80 mc, across which amplitude variations are produced corresponding to the envelope of the frequency modulated signal. Following the fm-am conversion signals are detected in a double diode and connected to the receiver base-band amplifier.

The receiver base-band amplifier unit transforms the impedance from the discriminator to a 124-ohm balanced or 75-ohm unbalanced output. The amplifier has a frequency response of ± 0.1 db from 60 cps to 6 mc and delivers a base-band signal of approximately 0 dbm balanced. The afc section ensures that the average i-f signal will be 70 mc by utilizing the averaged dc error signal derived from the discriminator to control the voltage to the klystron repeller.

Meter panel and power supply

A metal panel, common to the transmitter, receiver and power units, provides means for checking operating voltages and currents; continuously monitoring the transmitter power output; and blower cooling of the transmitter klystron. The receiver klystron, operating at a lower output, is convection cooled.

All transmitter and receiver units are powered from and ac-operated unit in the radio equipment bay. The power supply includes silicon diode rectifiers and filters for dc voltages (200, 400 and 600 volts), and a transformer for ac filament supplies. A magnetic amplifier regulates the ac line voltage to maintain constant output voltages. Commercial requirements are 117 volts 60 cps, 375 watts for one T-R bay.

Antenna system

In general TJ antenna installations will use a "periscope" arrangement (fig. 4) consisting of a 5-ft. paraboloid antenna mounted on the roof of the equipment building and directed to a reflector on a tower.

The antenna-reflector combination may, under optimum conditions, result in an increase in gain over an antenna alone, at the same time avoiding long waveguide runs. Where elevations are sufficiently high, 5-ft or 10-ft paraboloid antenna may be mounted on a tower and directed toward the distant station.

The 5-ft antenna is equipped with a radome which affords protection for the antenna feed and eliminates the need for a heater. The gain is 42.1 db compared to an isotropic radiator. The 10-ft size provides a gain of 48

db approximately and has an antenna feed heater in place of a radome. Reflector sizes are 6 ft x 8 ft plane or 8 ft x 12 ft plane or curved.

Where TJ and TD2 routes traverse the same radio path, 4 and 11 kmc signals may be coupled to a single horn-reflector antenna.

Signals between radio equipment and antenna are transmitted in WR-90 rectangular waveguide to the base of a circular waveguide (WC-75) antenna feed where opposite polarizations are combined in a dual polarizer network.

Short waveguide runs and small size waveguide (0.9 in. x 0.4 in. inside dimensions) require a dry air supply of low capacity to maintain pressure above atmospheric. A dehydrator of 15 cu ft per day output is sufficient for a repeater or terminal station.

Standard towers, both guyed and self-supporting up to 300 feet, are designed for stability requirements of ±¼-degree tilt and ±½-degree twist under 20 lb per sq ft wind loading (70 mph).

Base-band diversity switch and transmission unit

At the radio equipment base-band input and output, a diversity switch and transmission unit (fig. 5) provides means for connection to message multiplexing or video circuits; switching between two receivers; parallel connection to two transmitters; and connection to order wire and alarm circuits.

Frequency diversity switching over each repeater section is controlled by a logic circuit and comparator which selects the better of the two radio receivers of a diversity pair. If a fade exceeds a pre-determined value the comparator will initiate a switch provided the received signal of the alternate channel is stronger by a selected amount. Similarly, the comparator will initiate a switch, in the event of equipment failure, under the influence of pilot tones.

The actual transfer from one receiver to the other is accomplished through make-before-break contacts of a wire spring relay. In this operation there is no interruption of the signal, except in the case of equipment failure.

Fig 4. Antenna-reflector arrangement

Alarm and control system

Order wire communication and transmission of alarms to a control centre are facilitated by means of an alarm and control system, type D2. The order wire channel occupies a voice-frequency band 3 kc in width and may be transmitted over a TJ radio channel or a separate facility.

(Continued on page 38)

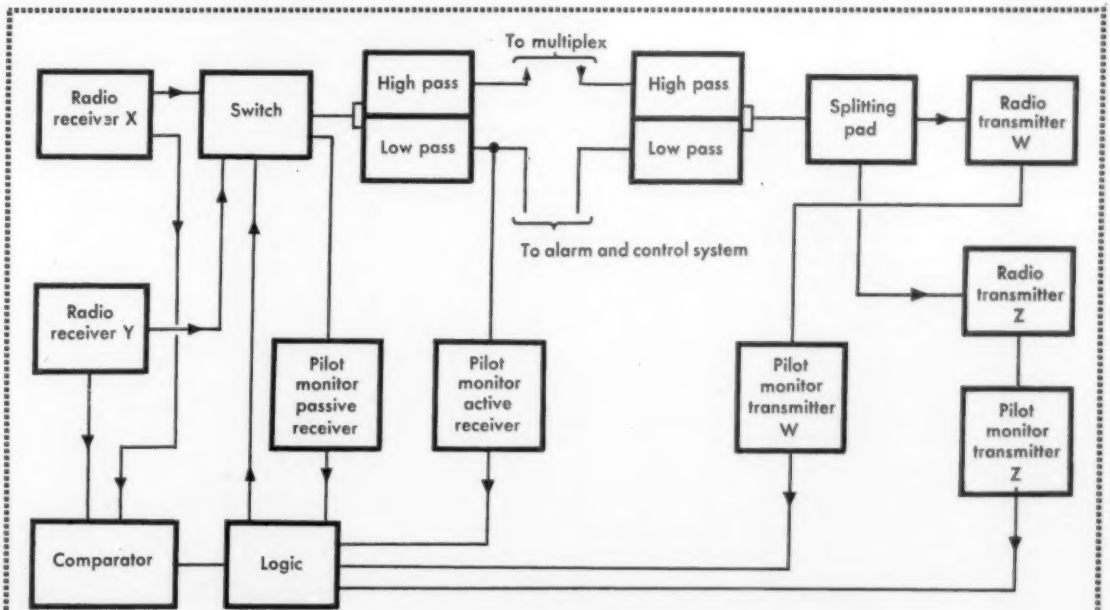

Fig. 5. Diversity switch and transmission unit block schematic diagram

Slow-scan technique was first used to transmit items relating to 1959 visit to Canada of H.M. Queen Elizabeth and H.R.H. Prince Philip

Problems of transatlantic television transmission by undersea cable

R. J. HALSEY, MIEE* & A. R. A. RENDALL, PHD, MIEE†

Two eminent authorities on cable transmission and television consider the technical problems involved in transmitting television signals over existing and future transatlantic cables, and assess the possibilities of success by this means. Reference is made to the slow-scan technique, which has already been used for short news items

The possibilities of transmitting television signals across the Atlantic have exercised program companies and transmission engineers for a number of years, hopes being mainly centred on a radio-relay system using tropospheric scatter on the northern route, via Iceland and Greenland. Despite optimistic pronouncements regarding such a system it has not yet proved practicable, partly because the useful range of tropospheric scatter systems seems to be less than has been claimed, and partly because of the intrinsic difficulties of the terrain. Other proposals have included radio-relay by way of aircraft over the Atlantic and by way of earth satellites.

Since the opening of the first transatlantic telephone cable system in 1956, there has been a good deal of speculation on the prospects of television transmission over this or future cables. We consider here the technical problems involved and assess the possibilities of success by this means in the foreseeable future.

Reasonably satisfactory conversion

Television standards differ in various countries, and nowhere in Europe is the American 525-line, 60-fields per second system employed. A reasonably satisfactory conversion in respect of the number of lines can be effected by re-scanning; this is common in Europe, where several different line standards are in use. Conversion in respect of field frequency is more difficult, but there is no reason to assume that this aspect of the problem cannot be solved satisfactorily. The video bandwidths appropriate to the various systems range from 3 to 10 mc; the lowest applies to the British 405-line, 50-fields/sec system. On long coaxial cables video-frequency transmission is impracticable; the International Telegraphy and Telephony Consultative Committee of the International Telecommunications Union (CCITT) recommends[1] that television signals should be transmitted as the upper sideband of a 1.056-mc carrier, with a vestigial lower sideband extending down to 0.5 mc, that is, 3.5 mc in all for the British system, as in fig. 1.

In studying the present problem, therefore, we shall have to consider, first, the possibility of transmitting a frequency band of 3.5 mc, or something approaching this, over a transatlantic cable some 2,000 nautical miles (nm) in length and, secondly, the possibilities of transmitting television signals over a much reduced bandwidth and, particularly, the bandwidth available or likely to be available on transatlantic cable systems.

Characteristics of various cable systems

Both the Scotland-to-Newfoundland section of the 1956 cable (TAT-1) and the France-to-Newfoundland sec-

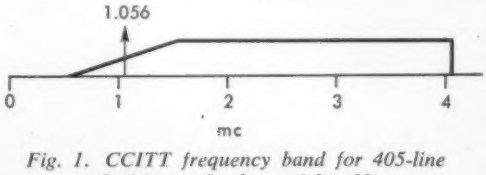

Fig. 1. CCITT frequency band for 405-line television-on-land coaxial cables

*Director of Research, U. K. General Post Office.
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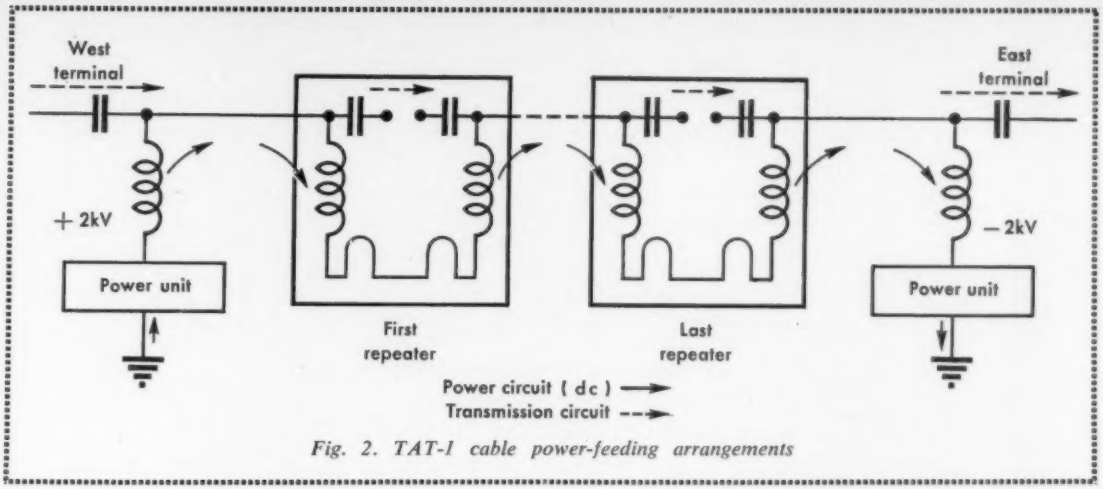

Fig. 2. TAT-1 cable power-feeding arrangements

tion of the projected 1959 cable (TAT-2) utilize two unidirectional cables. With 51 repeaters in each, spaced at 37 nm, provide for transmission bands approximately 16-164 kc, that is, 148 kc wide. The repeaters are energized by power units, each about two kilovolts, located at the terminal stations and driving a constant, direct current round the system, the power circuits of all the repeaters being in series (fig. 2). This arrangement requires power-separating filters in each repeater, the high-pass filters being in the transmission circuit.

For telephony, it is cheaper to transmit in both directions over a single cable when this is possible within the terminal voltage limitation; the development of the United Kingdom-to-Canada (CANTAT) system, due for completion in 1961, has been along these lines. In this system, a bandwidth of 240 kc is provided in each direction, using directional filters (as well as power-separating filters) in each repeater and with the 90 repeaters involved on the Scotland-to-Newfoundland section, the direct current feed voltage at each terminal will be 4.5 kv.

Delay distortion probable

Thus, a gross bandwidth of about 148 kc exists now and some 240 kc will be available in 1961; we shall see later, however, that in neither case is the full bandwidth likely to be suitable for television transmission because of delay distortion in the essential filters.

For a cable of given size the maximum transmitted frequency is determined by the number of repeaters which can be energized with the maximum permissible terminal supply voltage; this in turn is settled mainly by the design of the capacitors in the power-separating filters in the repeaters. Thus, if the line current is 0.4 amp and the maximum terminal voltage is 5 kv as at present, then the voltage drop in a 2,000-nm cable might be 2.3 kv, leaving 7.7 kv to energize 110 repeaters at 70 volts each—a typical requirement for the usual 3-stage amplifier.

New lightweight cable

Whereas the TAT-1 system uses conventional armoured cable having a core diameter of 0.62 in. (fig. 3a), the CANTAT system will employ, over three quarters of its length, a new design of lightweight armourless cable with a one-inch-diameter core (fig. 3b). The high-frequency attenuation of either type of cable is roughly $0.0027 \sqrt{f/d}$ db/nm, f being the frequency in cps and d the core diameter in inches. For a one-inch core the attenuations are about 2.7 and 5.4 db/nm at 1 and 4 mc respectively.

Lightweight cable of somewhat greater core diameter would no doubt be practicable but, the capacity of the cable ship being inversely proportional to the square of the cable diameter, greater diameter would involve splices in very deep water as well as other laying complications.

The maximum gain which can be provided by each repeater, assuming adequate negative feedback for the desired linearity, will depend upon:

(a) the minimum permissible level at the amplifier input, as determined by circuit noise;
(b) the maximum permissible level at the amplifier output, as determined by overload characteristics in relation to the peak signal power;
(c) the loss due to extraneous networks such as filters and equalizers; and
(d) the margins which must be allowed for changes in cable attenuation—anomalous changes on laying, temperature variations and ageing—and whether these can be wholly or partly absorbed by automatic level control in the repeaters.

International requirements

The CCITT standard for a 2,500-km (1,350-nm) television channel requires that the rms weighted noise shall be at least 50 db below the peak-to-peak picture signal; the noise will arise mainly from thermal agitation at the input of each amplifier and, in a 3.5-mc band, will be about —105 dbm; each repeater will make this contribution. The minimum permissible signal level can thus be determined when the approximate repeater spacing is known.

The maximum permissible level at the output of each amplifier will depend on the power-handling capacity of the output stage at the highest frequency transmitted. With the class of long-life tube now available, this is about +22 dbm for top frequencies less than about 0.5 mc, decreasing, above this, by about 3 db per octave. The outcome of these considerations is that, after allowing for equalizer losses, but without making any allowances at all for misalignment and subsequent cable changes, a system to transmit up to 4 mc over a one-inch core could employ repeaters having about 50 db maximum gain, spaced at 9.3 nm—216 for the 2,000-nm crossing, to overcome a total attenuation of 10,800 db.

Further voltage increase necessary

Even with this idealized arrangement, the power-feeding voltage would need to be increased to 9 kv—twice the present limit. A further increase is necessary because we

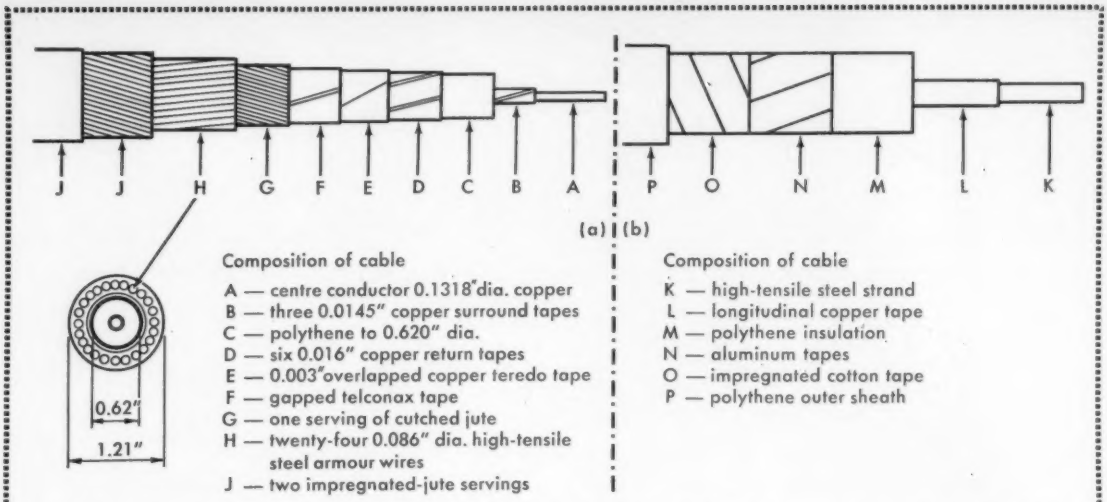

Fig. 3a. Deep-sea armoured submarine cable (TAT-1); Fig. 3b. Lightweight armourless cable (CANTAT)

find that, to obtain adequate negative feedback at 4 mc it is necessary to use more than three tube stages. To obtain adequate gain stability and freedom from non-linear distortion we must provide some 30-35 db gain-reduction by negative feedback. With the present tube this becomes impracticable, with only three stages, at about 1.5 mc; at 4 mc the number of tubes would probably need to be doubled.

To take account of anomalous changes of cable attenuation on laying and other factors leading to initial misalignment of the system, together with temperature and ageing changes after laying, would require either substantially lower gain or means for automatic gain control in each repeater. The latter requires a degree of complication never, so far, attempted in such a system, as well as a substantial increase in the power required in each repeater. (The L3 land coaxial system[2], which incorporates agc, requires 150 watts per repeater—five times that assumed for a submerged repeater.)

Decreased attenuation

On the TAT-1 system the attenuation at 150 kc has decreased by some 10 db (0.3%) in three years and the decrease appears to be asymptotic to about 15 db (0.5%). On a one-inch conventional cable the latter would be equivalent to some 27 db at 1 mc and 55 db at 4 mc, and automatic level control would clearly be essential. It is likely that lightweight cable is much more stable both in this respect and as regards anomalous laying changes; for the CANTAT system, a gain allowance of only 10 db (0.2%) has been made for misalignment and all cable changes. (More can be accommodated by using compandors on the telephone circuits.) On this basis, the gain allowances in our 2,000-nm system would have to be 10 and 20 db at 1 and 4 mc respectively. The need for automatic level control must remain uncertain until more experience with lightweight cable has been obtained.

We have seen that, with 5 kv terminal voltage, 110 repeaters could be energized; if we again allow 10 db for misalignment and cable changes, it is then possible to operate at frequencies up to a little over 1 mc. To extend this to 1.5 mc, the maximum at which three stages will suffice, we require 140 repeaters, each of 48 db gain. To energize these we must either raise the terminal voltage to 6 kv, provide a separate power-feeding cable to an intermediate point, or reduce the voltage available in each repeater to about 55 volts. It seems likely therefore that, one way or another, it should be possible to provide a 1.5-mc system; this, however, is likely to be the practicable limit with tubes of the present type.

Tube life a difficult problem

While better and more efficient tubes are possible, the problem of making them long-lived is a difficult one, and it seems likely that we should look to transistors for further improvements. There is no doubt that transistor amplifiers of adequate bandwidth and reliability will become available, possibly in time for a transistorised system to be laid within seven or eight years; they are certainly not available yet. Both the voltage and current requirements of transistor repeaters will be lower than for the present tube units, and this will enable many more to be operated in tandem with reasonable terminal voltages.

The effect of a substantial increase in the number of repeaters on the out-of-service time of the system is vitally important. On the basis of 10% repeater failures in 20 years, on which TAT-1 was postulated, the average number of faults per annum on a system of 300 repeaters would be 1.5; this might well involve six weeks' out-of-service time and cost $500,000. To reduce the number of faults the reliability of all the components must be correspondingly increased and this must always be an overriding design requirement.

Economics must be considered

Even with transistor repeaters it is unlikely that transmission of a full conventional television bandwidth will be achieved. Though this might eventually be technically possible, the economics of the problem are bound to lead to some measure of bandwidth conservation.

Bandwidth compression of television signals generally can be effected in three ways:

1. reduction of redundancies in the picture information;
2. sacrifice of picture quality; and
3. exchange of frequency bandwidth for time by a slowed-down scanning mechanism.

Reduction in redundancies

There are three distinct types of redundancy in a television picture[3]. First, the brightness variations along the

scanning line are not random; secondly, a number of adjacent scanning lines contain identical or nearly identical information; and, thirdly, successive pictures are identical except in those parts where movement has occurred. Removal of redundancies does not, in itself, achieve bandwidth compression; it is also essential to store and redistribute the non-redundant information so that it is transmitted at a constant rate. Information theory indicates[4] that a 7:1 reduction in bandwidth might be achieved by quantizing and coding the brightness information, but the means of achieving such economy involve formidable problems which will require much development before a solution is available. Work is proceeding in this field at a number of laboratories.

Sacrifice of picture quality

If the video bandwidth of a television transmission system is reduced below that normal for the system concerned, the rate of transmission of information will be restricted and picture quality will suffer. To take optimum advantage of reduced bandwidth it is necessary to effect economies in all three of the directions corresponding to the types of redundancy outlined.

Along each scanning line the transition rate from one degree of brightness to another can be reduced; edges then become more blurred but the more gradual tonal transitions are unaffected. The subjective satisfaction of a picture depends very largely on the sharpness of edges and the permissible deterioration can only be determined subjectively. Such tests using normal British 405-line signals indicate that, if the transmission system is free from delay distortion, the picture quality remains reasonably tolerable for topical events when the video bandwidth is reduced to about 1 mc, that is, a 3:1 reduction.

In like manner, vertical detail can be sacrificed by reducing the number of effective lines. In the final presentation, the full number of lines of the appropriate television standard would have to be restored and the over-all result would be that successive lines would contain less change of information than in the original. If the original contains an edge slightly inclined to the horizontal, then all line scanning systems must reproduce this edge as an irregular curve: if the number of lines is large, the eye fails to distinguish any irregularity, but the coarseness of the structure of the picture becomes more apparent as the number of lines is reduced. A further harmful effect introduced by reducing the number of lines is aggravated moiré patterns; such patterns are generated by interference between the frequency of a pattern in the original scene and the scanning frequency. With fewer scanning lines this interference occurs with larger detail in the picture and is more obtrusive.

Flicker must be avoided

Finally, we can reduce the number of pictures transmitted per second. The presentation to a viewer must have a sufficient picture repetition rate to avoid flicker, but a reduction might be made on an intermediate link, and jerkiness of movement would be the price paid. If the original scene is slow-moving, then little information is lost by reducing the picture repetition rate, but if it were a fast moving game, such as baseball, then the players and ball would proceed from place to place in a number of jerks, or the movement would be blurred.

For any particular reduced bandwidth which may be available there will be an optimum distribution of the above economies, which can only be assessed subjectively; many tests and observations would have to be made before optima could be determined. Once so determined, substantial effort would be required to design and produce terminal equipment to effect the necessary conversions; the over-all system must accept the standard television signals of the country of origin and deliver the standard signals of the country of presentation. In the end, the loss in quality must be weighed against the interest aroused by televising a particular occasion. The choice may well be of accepting a sub-standard picture or none at all, a decision which will depend on the balance between the degree of deterioration which must be accepted and the satisfaction of being an immediate viewer of a particular event.

Exchange of bandwidth for time

If a video program is recorded on tape, it can be transmitted at a lower speed, re-recorded at that lower speed at the distant end and finally reproduced at normal speed. This constitutes a direct exchange of bandwidth for time and, within reason, the bandwidth could be reduced by any factor if the transmission time were similarly expanded; it is very probable that special magnetic recording equipment would have to be developed for the purpose. This process takes no account of different television standards on the two ends and would not be admissible alone.

A more attractive solution is to record the event on film, scan the pictures at a slow speed for transmission over the cable, re-record a film at the receiving end from a cathode ray tube display and then rescan the film; the different television standards at the two ends then present no obstacle. A proportional delay is introduced by the slow-speed scanning and there are fixed delays for film processing.

This method has been used for short news items relating to the visit of Her Majesty the Queen to Canada. These were transmitted over the cable between Montreal and London by the British Broadcasting Corporation in collaboration with the CBC.

The system used exchanges bandwidth for time, alternate frames of a 16-mm tele-recording being scanned at 200 lines/picture and 25 lines/sec. Thus, two film frames are disposed of every 8 sec, a time expansion of 100 : 1. The horizontal definition is 360 picture-elements/line. The final video-frequency band, extending from a fraction of a cycle per second to 4,500 cps, is amplitude modulated on a carrier of 5,000 cps and transmitted as a vestigial-sideband signal in the band 500-5,500 cps. To improve the signal-to-noise ratio, 160% modulation and synchronous detection are employed. The cable link consisted of a normal program channel (50-6,500 cps) with special delay equalization.

These transmissions have been generally very succesful and for short items the method is very much quicker than using aircraft to fly the film across the ocean.

Problems of reduced-bandwidth transmission

In the methods discussed above the resultant picture signal will contain components of frequencies from that represented by the picture repetition rate to the highest frequency required for the detail transmitted. In the last method, the exchange of bandwidth and time, components at very low frequencies, even fractions of a cycle per second might exist in the signal. Transmission over a cable will necessarily involve a vestigial sideband and, as indicated earlier, this amounts in a normal transmission to 0.5 mc or about 14% of the total bandwidth. When time and bandwidth are interchanged this proportion will remain fixed, but with either of the other methods means must be found to reduce the vestigial sideband very substantially; this requires special attention to filtering and shaping techniques.

On repeatered submarine cable systems, the inherent delay distortion is so great as to be outside the experience of television circuit engineers. The reduction of this distortion to the requisite limits over the greatest possible part

of the available frequency band is one of the major problems which would have to be faced if we attempt to use the telephone cables for television transmission; even with the best possible correction, the full bandwidth will not be suitable.

Difficult to compensate

In a unidirectional system such as TAT-1, the lower frequency is determined by the power-separating filters which contribute considerable delay distortion of a nature which is exceedingly difficult to compensate. On TAT-1 it is unlikely that a bandwidth of much more than 100 kc, out of the total of 148 kc, could be made suitable, and some of this would be needed to accommodate the vestigial sideband.

A single cable system such as CANTAT also requires directional filters in each repeater and these, even more than the power-separating filters, cause substantial delay distortion toward cut-off: again the high-pass filter will be particularly difficult to compensate. With CANTAT it is unlikely that the bandwidth available for television could be as much as 200 kc — perhaps 170 kc — and, again, the vestigial sideband must be accommodated. It is clear that with the same gross bandwidth restriction, single-cable systems will always be substantially inferior to two-cable systems for television transmission, because of the inherent delay distortion in the directional filters.

Possible Use For Special Events

On the existing TAT-1 cable a gross bandwidth of about 148 kc is available but the delay distortion is very severe and it is unlikely that much more than 100 kc could be made suitable for television; TAT-2, completed last year, is a similar system. On the CANTAT cable, due for completion in 1961, the gross bandwidth available will be 240 kc but, here again, delay distortion is likely to restrict the usable band to, perhaps, 170 kc. If it is practicable to restrict telephone service so that optimum use could be made of these cables for television — a matter outside the scope of this article — it will probably prove possible, in due course, to transmit comparatively low-grade television on a non-delay basis. This might well suffice for special events in the absence of anything better, but is unlikely to be adequate for general application. By exchanging bandwidth for time, either with or without other forms of compression, it is possible to transmit pictures of good quality. The extended time scale makes this form of transmission unsuitable for anything but short items. However, it is the most readily applicable method.

It seems unlikely that a conventional television circuit of the standard used on land, or even something approaching this, could be provided for some seven or eight years, by which time a transistorized system might be fully developed.

Helpful To Integrate Requirements

The economics of system design show that it would be worthwhile to spend a good deal of money on terminal equipment to eliminate redundancies and thereby reduce the bandwidth requirement. This, it seems, is the way events should go, in which case a bandwidth of, say, 0.5 to 1.0 mc should suffice for a good picture. An 0.6-mc system could clearly be built any time after 1961; it would merely be a two-cable version of CANTAT. We have seen that a 1.0- to 1.5-mc system should also be practicable, using tubes of the type now available, if present hopes of the attenuation stability of lightweight cable are realized.

Whether transatlantic television can be justified economically — the capital cost might well be as much as $50 million for the ocean crossing alone — is not a matter for consideration here. It would, however, be helpful, as in any communication system, to integrate requirements: a television channel of restricted bandwidth might well be provided, ultimately, as part of a more comprehensive system. It could then be accommodated in that part of the transmission band which is least subject to delay distortion. END

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11 kmc microwave system—continued

A 2,600 cps tone is used to signal alarms and controls over the order wire circuit.

The D2 system serves up to 14 substations from a control or main station, which is capable of receiving 18 alarms and 6 indications from each substation, and sending 11 orders to each substation.

Auxiliary and emergency power

The order wire, alarm and control bay requires —48 and +130 volts for operation of the base-band switching, order wire and alarm equipment. Rectifiers may be located in the bay when ac operation is desired.

Five-kilowatt gas and 10-kw diesel engine alternators are designed as emergency power sources in the event of ac line failure. They may be either "no-break" type or automatic start; the latter interrupt service for about 50 seconds upon taking over the TJ load.

Maintenance and test equipment

For in-service measurements the meter panel on the transmitter-receiver bay provides an indication of power supply voltages, klystron currents, and rf output and input levels.

To minimize requirements at individual stations, test equipment is located in maintenance centres along a route. Commercially available test equipment is employed except in a few instances where units are designed specifically for TJ radio.

Acknowledgement

Appreciation is due to a number of persons at Bell Telephone Laboratories engaged in the design and development of the TJ system, and in particular to Mr. J. Gammie of Merrimack Valley Laboratories. END

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U.K. electronic exports to Canada

Latest figures show increase in many categories

In response to reader requests following publication of our 1959-1960 Industry Review and Forecast (CEE, January 1960), further information has been obtained on Canadian electronic imports from the United Kingdom.

The breakdown given below was prepared for CEE by the United Kingdom Trade Commissioner in Toronto. A dash (—) indicates that no shipments were made during the period concerned; n/a means not available.

Classification	1958, $	Jan.-Sept. 1959, $
Electronic and nucleonic valves and tubes		
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excluding mercury-arc rectifiers), photo-electric cells, stabilizing and cold cathode tubes, magnetrons, klystrons	65,242	52,726
Cathode ray tubes	10,270	9,406
Other types not exceeding 50 watts plate dissipation (including crystal diodes, transistors, X-ray tubes, etc.)	188,006	294,039
All other types	44,539	200,162
Parts for tubes and valves (excluding glass bulbs)	8,874	4,155
Apparatus for telegraphy, telephony, radio, television and radar (including tubes forming part of the apparatus and exported therewith)		
Radio transmitters for public broadcasting, complete	—	—
Television transmitters, complete	15,532	—
Radio communication, navigational aid and radar equipment, complete	2,467,807	2,282,336
Domestic radio receivers, mains, complete	8,778	2,546
Domestic radio receivers, battery, complete (including vibrator sets)	279	3,072
Domestic radio receivers, other, complete (including mains/battery and auto)	45,526	156,804
Radio-phonographs, complete	48,505	8,432
Radio receiver and radio-phonograph chassis, substantially assembled	854	3,136
Television receivers and chassis substantially assembled, with or without sound reception	473	3,147
Public address equipment	16,628	24,392
Loudspeakers and microphones, separately consigned	316,761	245,595
Other radio and television apparatus, not elsewhere specified	47,574	40,961
Components and parts, not elsewhere specified	1,632,046	1,315,152
High frequency induction and dielectric cooking and heating equipment	21,918	31,212
Electro-medical apparatus (excluding deaf aids, X-ray apparatus and batteries)	22,565	38,533
Industrial electronic control equipment (including tubes forming part of the apparatus and exported therewith)	27,020	119,062
Radio testing equipment (including tubes forming part of the apparatus and exported therewith), not elsewhere specified	150,665	196,579
Primary batteries and/or cells for radio	3,423	160
Primary batteries and/or cells for telephone, telegraph and signaling	64,132	487
Telegraph and telephone equipment, complete (excluding test equipment)	2,662,213	1,712,215
Telephone instruments, separately consigned	97,683	209,595
Parts for telegraph and telephone equipment, not elsewhere specified	1,030,040	863,771
Line apparatus for long distance communication (carrier, duplex and repeater) and speech input equipment	265,463	992,927
Telegraph and telephone test equipment (including tubes forming part of the apparatus and exported therewith), not elsewhere specified	46,047	50,410
Musical instruments and phonographs (including record players and tape recorders)		
Phonographs (including record players) with electrical amplification, complete (including tubes exported therewith)	41,222	14,848
Record players, complete	26,100	n/a
Record playing mechanisms, without electrical amplification, complete, whether or not in cabinet, with record changers	1,758,076	1,135,112
Ditto, without record changers	111,175	38,424
Parts and accessories for phonographs, record players and mechanisms (including styli but excluding records)	244,020	162,255
Tape recorders and tape reproducers, complete (excluding office machinery)	77,906	35,163
Tape decks and other parts, not elsewhere specified	—	3,844
Recording tapes of all materials	6,738	10,643
TOTAL	**$11,574,105**	**$10,261,124**

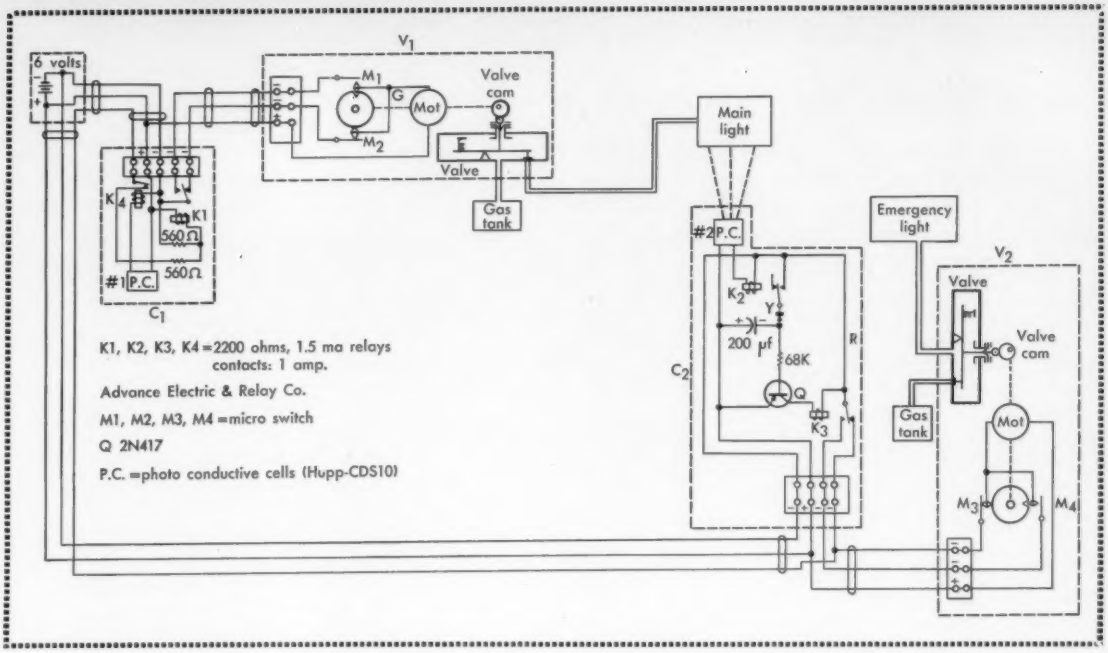


Photo cells control acetylene lights in unattended lighthouses

H. ROSS SMYTH, J. C. BARNES & R. BEAULIEU*

At the request of the Department of Transport, scientists at National Research Council have developed a control for acetylene light in unattended lighthouses. The control monitors the main light at night; in the event of failure, an emergency light is turned on and the gas supply to the defective light shut off. Both lights are turned off during daylight hours.

The Lighthouse on the West Point of Sable Island is being modified for the unattended operation of a 100,000 candle power acetylene light. To realize maximum saving of gas, the Department of Transport requested the National Research Council to develop the necessary gas valve system to control the supply of gas to a main light and an emergency light.

Method of operation

The supply of acetylene to each of the lights goes through a reducing valve to a pressure of approximately three pounds. A small portion of the gas supplies a pilot flame on each light. The main supply goes through small plunger-operated valves to the main and emergency lights.

Each plunger valve is actuated by a motor driven cam, the motor of which is controlled by a photo-sensitive cell and a double pole single throw relay. Limit microswitches operated by a cam cause the motor to open the gas valve at night and close it during daylight hours.

At night the main light burns steadily, and a rotating lens system directs the light seawards: two short flashes are produced every half minute. Another photo-sensitive cell placed in the beam of the main light controls a 1-minute delay circuit to keep the supply of gas to the emergency light shut off. Failure of the main light is detected by this control after one minute, and the emergency light is turned on and the gas supply for the defective main light is turned off.

During daylight hours the two controls maintain the gas supply off at both lights.

Main light

The control for the main light consists of photo-sensitive cell (PC #1) in series with relay K4. In daytime, contacts of K4 are open; so the power applied through a 560 ohm resistor energizes K1 and holds valve VI closed. At night K4 closes and grounds K1 through the low impedance motor of V2 and a 560 ohm series resistor. There the voltage across K1 is too small to hold it closed and K1 opens to energize the motor of VI. This motor turns a valve cam and a switch disc half a turn until a microswitch (M1 or M2) falls into a notch on the disk and opens the circuit and turns the motor off. The light

*National Research Council, Ottawa.

is now ready to flash (two 1/3-second flashes every 30 seconds).

Emergency light

The control system for the emergency light is slightly different from the other one. When the main light is flashing regularly, or in daytime, the emergency light remains off.

To keep it off when the main light is flashing a delay is required. This delay is obtained by charging a capacitor through relay K2 in series with photo-conductive cell PC #2 (exposed to the main light) each time the main light flashes, and allowing the capacitor to discharge through the base of a transistor. A diode is included in the same circuit so that if the battery is connected backwards it will not damage the electrolytic capacitors.

In daytime another photo-conductive cell in parallel with the one mentioned above, and exposed to daylight, holds relay K2 closed. The capacitor connected across the line draws current through the base of the transistor. In both cases this base current keeps the transistor on and relay K3 in the collector circuit remains closed to hold the emergency light off.

When the capacitor charge decreases, current in the collector becomes insufficient to hold K3 closed and this turns on the emergency light. When valve V2 is open, M3 opens the main circuit which was grounding K1 in the main light control. Thus, K1 is re-energized and closes the main light valve to prevent any explosion hazard from gas escaping all night from the defective or extinguished main light.

In the morning, because the delay control system is more sensitive than the other one, the emergency light turns off first, and at the same time, turns the main light on as long as the light falling on PC #1 is not sufficient to shut it off again.

Wher. the main light is flashing normally, the delay of the stand-by relay is long enough to hold the emergency light off. With a six-volt battery, the delay is approximately 55 seconds with a 200 uf capacitor; where the battery voltage falls to 4.65 volts, the delay will be reduced to 45 seconds. This is still much longer than the interval between each flash of the main light.

The drain from the battery is as follows:

In daytime	8.6 ma.
At night	2.6 ma.

Assuming that, over a period of one year, the average operation is 12 hours of night time conditions and 12 hours of daytime conditions, the total drain per day from a 6-volt battery will be:

In daytime	103.2 mah
At night	31.2 mah
Total drain per day	134.4 mah

Thus, the installation of a 50-ah general service battery will provide enough power for one year.

The battery voltage should not drop lower than 4.65 volts, otherwise the control of the valves cease, and the main and emergency lights will stay on all day.

Design provides safety features

Mechanical design on this equipment consisted of two parts:

(a) adaptation of an existing AGA valve to the new operating system, and

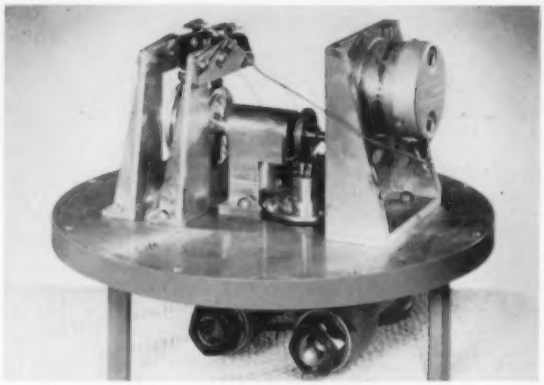
(b) the motor drive, cam shaft, etc.

The first involved merely a new type of over-travel spring.

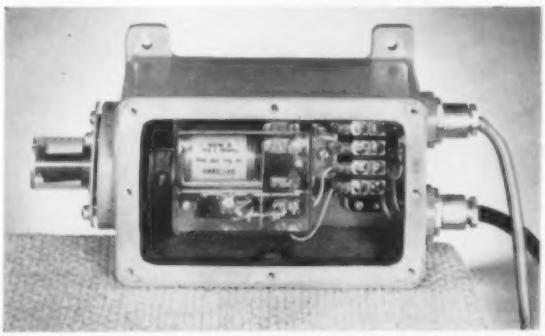
In the cam drive, instrument bearings were used to mount the cam-shaft, so as to prolong battery life. A miniature Oldham coupling served to connect the motor to the cam-shaft. The microswitch cams were made continuously adjustable through 360° in order to provide maximum flexibility in set-up procedure.

Every effort was made to seal the equipment against moisture by using brass castings, and rubber O-rings at all joints. Since this created a hazard in the vent of acetylene leaking into the motor chamber, a rubber diaphragm was sealed into an opening in the cover. This not only forms a safety blow-out point, but greatly reduces the possibility of leakage of moisture into the chamber, owing to "breathing." END

Complete lighthouse gas valve control system with the daylight switch and main light valve on the left, monitor switch and emergency light valve on the right.



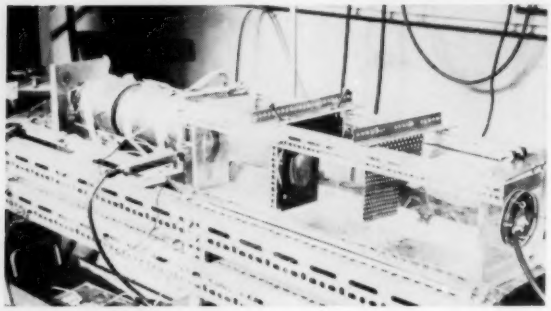
Acetylene valve with motor (right), cam and control valve (centre), limit microswitches and cams (left).



Daylight switch for main gas light showing mounting of relays inside box and photo sensitive cell at the end.

"TV" camera operates on sound waves 101

Two British scientists, Dr. C. N. Smyth of University College Hospital Medical School and Mr. J. F. Sayers, have built a television camera which creates an image from sound waves instead of from light waves. It can give an x-ray-like picture of the internal structure of metals and other engineering components as well as of the human body. It can also show underwater objects.



Above: Ultra-sonic equipment for detecting flaws in molecular structures of solids, or to act like an x-ray machine for clinical observations. At left: Sonic picture shows air bubble in aluminum block. Photos were taken by Dr. C. N. Smyth.

Sound waves are very similar to light waves and can be focussed in the same way with lenses, so that the image of an object exposed to noise is formed and can be reproduced at a distance.

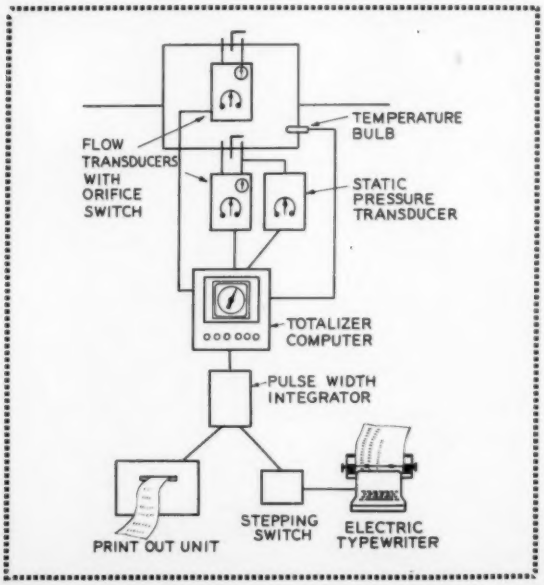
The ultra-sonic "television" camera has a sound-sensitive receiving surface (a bare slice of crystalline quartz) which develops, on each point of its surface receiving a sound impact, a voltage proportional to the ultra-sound intensity. The value of this voltage is detected, point by point, by a scanning electron beam. The signals are amplified and used to control the brightness of a TV receiver on which appears a visible image of the invisible internal structure under examination.

During a recent demonstration internal flaws in blocks of aluminum revealed their shape and size clearly; electroplating which was adhering badly to the base metal showed as dark patches. A clear view was obtained of the internal parts of goldfish and of some medical specimens, and when the lecturer put his hand in the tank, something of the structure of his finger tips and palm was seen.

It is claimed that the sound intensities are too small to have any harmful biological effect, so television from sound waves may prove important in the examination of parts of the body sensitive to x-rays.

Telemeter gives corrected flow measurement 102

The Bristol Company of Canada Ltd. has introduced a computing telemetering system for gas distribution and pipeline applications, designed to provide corrected flow measurement. It consists of flow and pressure transducers, a totalizing computing and transmitting instrument, and a pulse-width to pulse-count integrator with counters.



The Dyna-Servo transducer is a null balance instrument. A signal determined by the measured variable (temperature, flow, pressure) is fed from the error detector to an amplifier. The amplified signal is fed to a servo motor which positions a servo shaft for operating a retransmitting slide wire, encoder, alarms, deviation contacts, etc. The feed-back cam on the servo shaft can be contoured to provide exponential values.

The Dynamaster totalizing computing instrument includes down-scale, fail-safe and a Metameter transmitter. The instrument has manual adjustments for specific gravity and supercompressibility. Range change switches and check switches (for introducing finite values of temperature, pressure, flow, specific gravity, and supercompressibility) are also included. A flashing red light indicator in the door shows when any switch is in the check position.

The integrator receives the output signal from the transmitter in the Dynamaster and converts it from pulse-width to pulse-count. A cumulative counter and two counters for hourly totals are included in the instrument. The integrator has a range of 50-1, and a relay matrix automatically switches the integrator range when the Dynamaster range is changed.

In addition to the integrator, the receiving station may include a Metameter receiver for analog recording or digital read-out of corrected rate of flow.

Shielding improves i-r detector operation 103

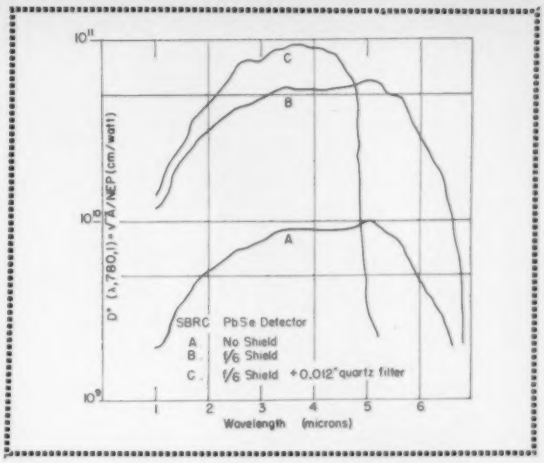
A recent discovery at Santa Barbara Research Center has pointed the way to improved performance of lead selenide detectors. It was found that detectivity is limited by ambient or room temperature radiation falling on the sensitive film. Although this effect is not new in the detector field, it had not been demonstrated previously with lead selenide.

By providing appropriate shielding in the detector package, improvements in detectivity of a factor of six to ten have been achieved. The shielding is designed to fit the optical system, since the improvement in detectivity is inversely proportional to the sine of half the angle subtended by the aperture at the detector. For example, with an f/2 system, proper shielding offers improvement of a factor of four relative to the standard package performance.

Fortunately, this improvement is attained by an increase in signal and noise level so that the shielded detectors are easier to use with conventional amplifiers. The time constant becomes longer with shielding; however, detectivity increases with frequency up to the frequency at which the signal begins to fall. Above this frequency, the detectivity drops about 2 db to 8 kc.

Another technique of restricting the amount of ambient radiation involves the use of spectral filtering. Selective filters on the detectors absorb light of wavelengths which are not contained in the signal radiation.

The results of employing these techniques are illustrated in the figure, where curve A is for a standard unshielded detector, B is for the same detector shielded for an f/6 system, and C is the same as B with a quartz filter added. This detector was 3 x 3 mm² in area and was fitted with a sapphire window. The measurements were made at liquid nitrogen temperature at 780 cps with a band-pass of 1 cps.



By taking advantage of these improved detectors, infrared system designers should be able to enjoy sizable improvements in system sensitivities. For example, the range of operation of a search and track system under development at SBRC was doubled when the former detectors were replaced with the improved version. In order to achieve optimum performance it is necessary to design the detector package coincident with the system because of the detector dependence on optical speed and spectral filtering.

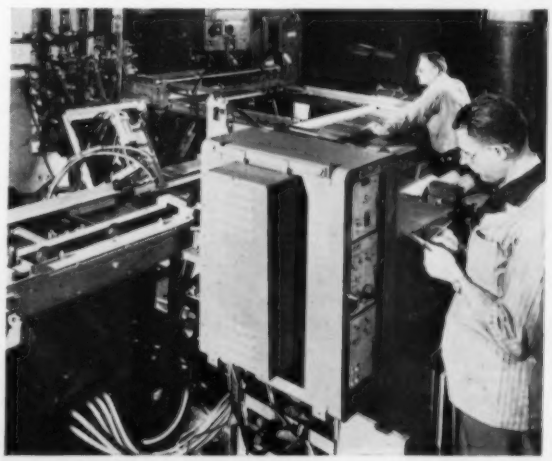
Computer accounts for variables in spotwelder 104

A new electronic spotwelding control that utilizes digital and analog computer elements, known as the "Monautronic V-2 Feedback Spotwelding Control," is now being manufactured for the welding industry by The Budd Company of Philadelphia.

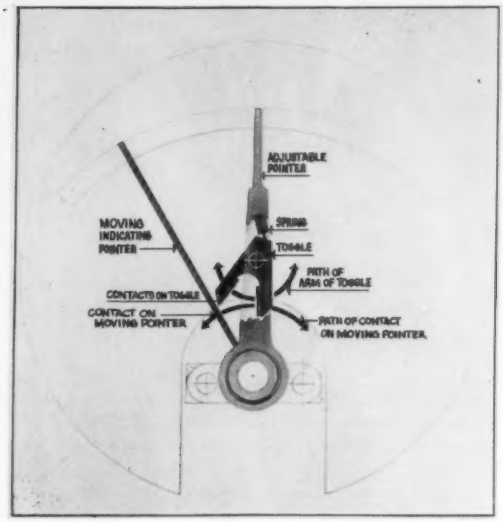
Among the types of weld variables compensated for by the new control are: line voltage fluctuations, changes in amount of applied electrode force, electrode wear, variations in surface finish, fitup, thickness or hardness of material; variations in amount of ferrous material in secondary circuit, contamination of metal surfaces, variations in horn and electrode lengths causing reactance changes, and proximity of other welds (shunting effect).

The V-2 Control obtains correct fusion temperature within each weld by relating the voltage across a given weld area to the ultimate temperature that will occur within the weld. The control system then measures the actual voltage at the weld electrodes and compares this value to a "command" voltage related to the desired temperature as previously "programmed" into the control—a known quantity based on previous welding experience for the particular type and thickness of metal and the weld strength desired.

The Control instantaneously compensates for any difference between the two voltages by making automatic heat adjustments for each weld as it is being formed. The "feedback" information on the voltage across the weld is "processed" by appropriate input circuits, similar to those used in radar and in both digital and analog computers. This feedback information makes the heat-input setting fully automatic. If conditions develop at the weld which would result in a substandard weld and which are beyond the available range of control as determined by the established settings, the Monautronic V-2 senses that it can't make a good weld under such conditions. It accordingly "locks-out" automatically, halting the welding operation, so that the operator can correct the nonweldable condition, then reset the control and continue making good welds.



New meter relay provides continuous reading 105



Meter-relays with a new design principle, retaining the reliability of locking contacts but providing instantaneous reset, have been developed by Assembly Products, Inc.

With the new CR (Continuous Reading) design, the moving pointer shows the signal level at all times, even when the set point has been passed and control circuits have been energized. The circuits remain operative until reset calls for opposite action.

Key to the new design is a V-shaped toggle, with contacts on each of its arms. The toggle is pivoted on the under side of the adjustable pointer that marks the set point. Both the toggle and the adjustable pointer are made of layers of isolated metal that are parts of separate circuits from the respective toggle contacts.

When the indicating, or signal, pointer reaches set point, a two-stage action occurs, almost instantaneously:

1) A contact on the pointer touches a contact on the toggle and a circuit is closed through both the booster coil and the coil of a multi-pole load relay. The booster coil assures firm meter-relay contact action.

2) As the load relay initiates the desired control action through one set of contacts, another set closes and pulls a surge of current through the meter-relay movement. Enough torque is thus added to the indicating pointer to cause it to snap the toggle and move past it. The meter-relay contacts are then separated and the booster circuit is opened. This sequence of action may begin at either high or low limit.

The load relay remains energized as long as the signal is higher (or lower) than set point. The indicating pointer moves freely with fluctuating signal strength.

When the indicating pointer returns to set point, its contact again touches a contact on the toggle. A circuit including the booster coil is closed and the load relay is dropped out. The indicating pointer snaps the toggle the other way and again pushes past, opening the booster circuit once more.

The design and positioning of the toggle are such that a contact on the indicating pointer always passes by the toggle arm closer to it and strikes the contact on the further arm. The indicating pointer has two isolated contacts, one touching a toggle contact while moving upscale, the other being operative when the pointer moves downscale.

Movement of pointer contacts across the toggle contacts exerts a wiping action that keeps contacts clean and makes for more positive action and longer contact life.

Mag-ray gauge measures millionth-inch 106

This gauge for measuring thickness of metal plating is so sensitive that it can be calibrated to indicate differences of one-millionth of an inch. It was developed by manufacturing research engineers at Boeing's Aero-Space Division.

The new gauge, actually two gauges in one, utilizes long-known electrical and radiation principles. One portion of the instrument measures capacitance changes; the other measures the intensity of beta-ray reflection. From this combination the entire device has been named a Mag-ray gauge.

The thickness of a ferromagnetic plating, such as nickel, is measured through the use of magnetic force. A magnet attached to a small spring deflects the spring when the magnet is placed close to the nickel plating. The spring deflection is measured by a capacitance meter which, after calibration, indicates the thickness of the plating. Non-ferromagnetic platings such as rhodium are measured by a beta-ray technique wherein the rays are focused on the material to be measured. The amount of the ray that is reflected indicates the plating thickness.

The gauge was developed for such measurements as

plating thicknesses on timer discs for Bomarc missiles, in which both nickel and rhodium platings must be measured. Future applications envisioned include measurement of ceramic coatings, paint and other thin skins.

In the picture, Boeing manufacturing research engineer Don Frazier holds one of the double-skinned Bomarc timer discs in his right hand while adjusting the beta-ray backscatter instrument with his left.

Gamma rays help confirm Einstein's theory 107

A team of four scientists in the Nuclear Physics Division at the Atomic Energy Research Establishment at Harwell, England, have completed two ingenious experiments using gamma rays from a source of radioactive iron which appear to confirm a basic promise of Einstein's general theory of relativity. The Harwell experiments were planned by Dr. T. E. Cranshaw of Southport, Lancashire, shown in photo, and Dr. J. P. Schiffer of Clarendon Hills, Illinois; a Canadian, Dr. A. B. Whitehead, of New Brunswick, and a New Zealander, Dr. H. J. Hay, collaborated with them.

Ever since Einstein announced his general theory of relativity in the earlier part of the century, scientists have looked for evidence confirming his predictions. One is the so-called "red shift" arising from the effect of gravity on light and all other forms of electromagnetic radiation.

In the first of the experiments, the scientists used electromagnetic radiation in the form of gamma rays produced by a radioactive isotope of iron. Using a watertower at Harwell, the three physicists, Dr. Cranshaw, Dr. Schiffer and Dr. Whitehead, arranged for gamma rays from radioactive iron to "fall" through the earth's gravitational field down an evacuated tube for a distance of 40 feet. The rays were then absorbed in iron of the same nuclear structure as the source, and by an ingenious experimental arrangement, careful measurements showed an alteration in the wavelength of the gamma rays close to that predicted by Einstein.

In the second experiment Dr. Hay collaborated with the team who sought confirmation of Einstein's prediction that there is no way of detecting any difference between a uniform gravitational field and the force of acceleration. The radioactive iron source was placed in the centre of a cylindrical rotor with an absorber of iron of the same

nuclear structure located at the outside surface. With the rotor spinning up to 30,000 revolutions per minute, accelerations were obtained up to 65,000 times as large as the acceleration of gravity on the earth's surface. Variation of the number of gamma rays passing through the absorber were observed at different speeds of rotation and the team observed effects consistent with Einstein's prediction.

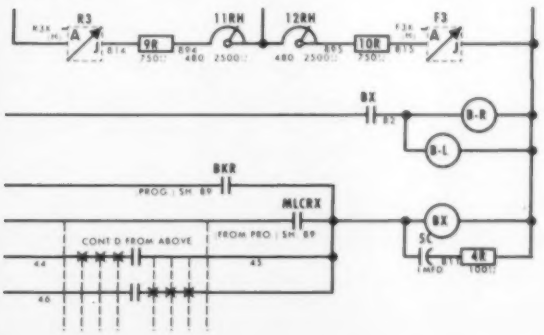
The radioactive source for these experiments was prepared on the University of Birmingham cyclotron by bombarding an iron target for one hundred hours with a beam of deuterons. The source was purified at the Radiochemical Centre of the U.K.A.E.A., at Amersham, England, and the final processing of both the source and the absorber was performed in the Chemistry Division of A.E.R.E.

"Typesetting" machine "draws" schematics 108

Now you can have your drawings made on a typesetting machine. Initially developed in co-operation with large industrial firms, this specially equipped Intertype Co. Fotosetter can reduce costly hand drafting time and turn out sharp, uniform drawings of electrical circuits and other complex engineering drawings.

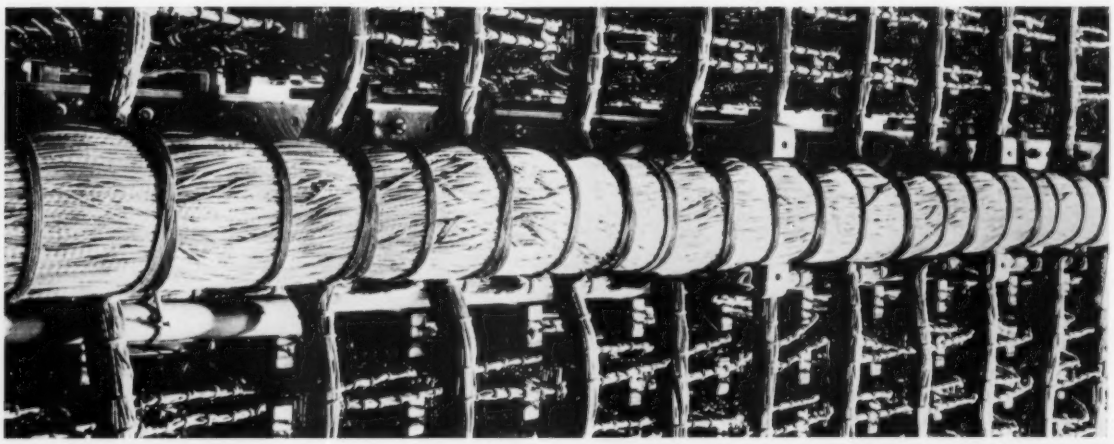
Finished diagrams emerge as transparencies ready for duplicating by standard procedures. Fotosetter diagrams can be one-fourth the size of normal engineering drawings, or even smaller.

In the photograph, the Fotosetter operator is following an engineer's rough sketch which serves as his "copy" in setting lines and symbols. Part of a finished drawing is also shown.

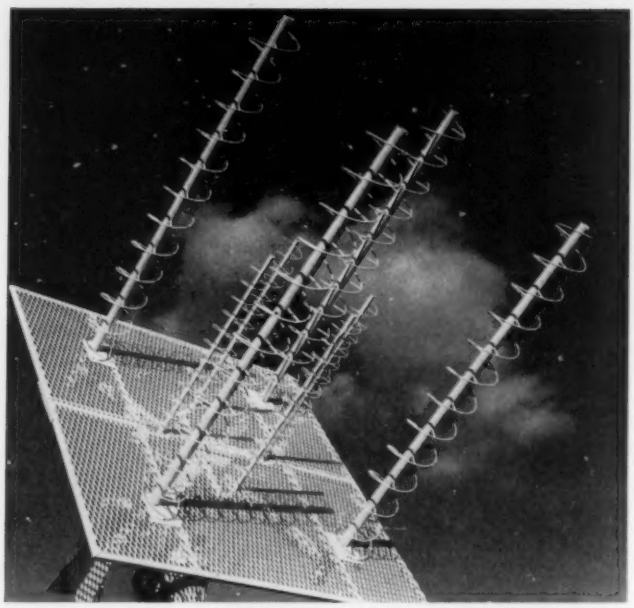


This "White room" for meter making is now in full operation at Stark Electronic Instruments Ltd., Ajax, Ontario. It provides complete control of dust, humidity and temperature. In addition, an environmental test lab has been installed in a separate building and contains a high impact shock machine for light equipment, vibration table, tumbler machine, and other equipment required for the performance of tests to MIL and JCNAAF specifications.

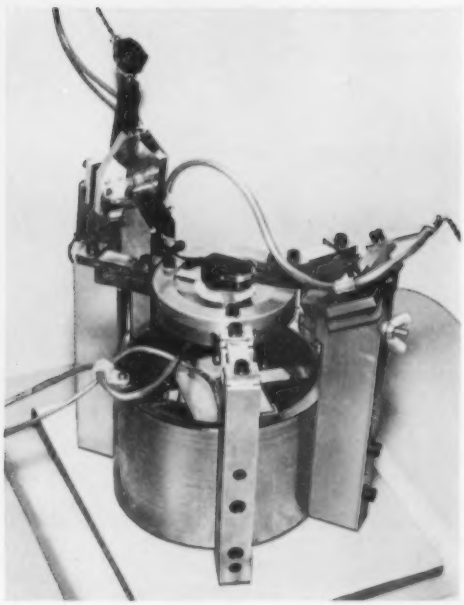
Test facilities are essential in our industry



This intricate pattern of wires interconnects the many relays that perform the complex memory and logic functions required of the "marker" in directing telephone calls through a No. 5 crossbar system. The photograph, supplied by Bell Telephone Laboratories, Inc., illustrates the importance of machine memory in telephone switching.

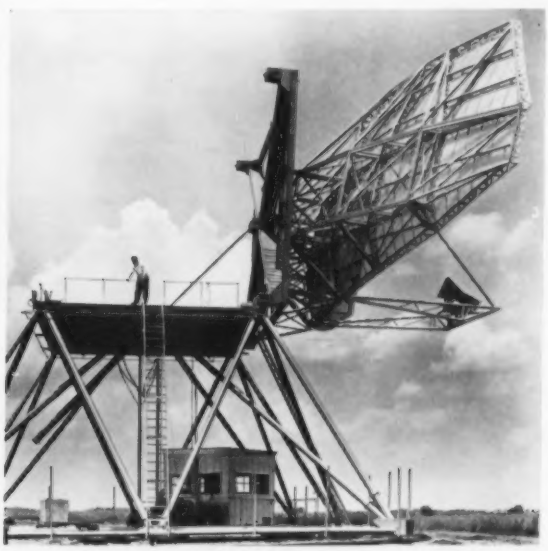


The Canoga Div. of Underwood Corp. is designing and manufacturing ground based telemetry, communications and control antennas for the NASA Project Mercury. The antenna complex will circle the globe on the path of an equatorial orbit.

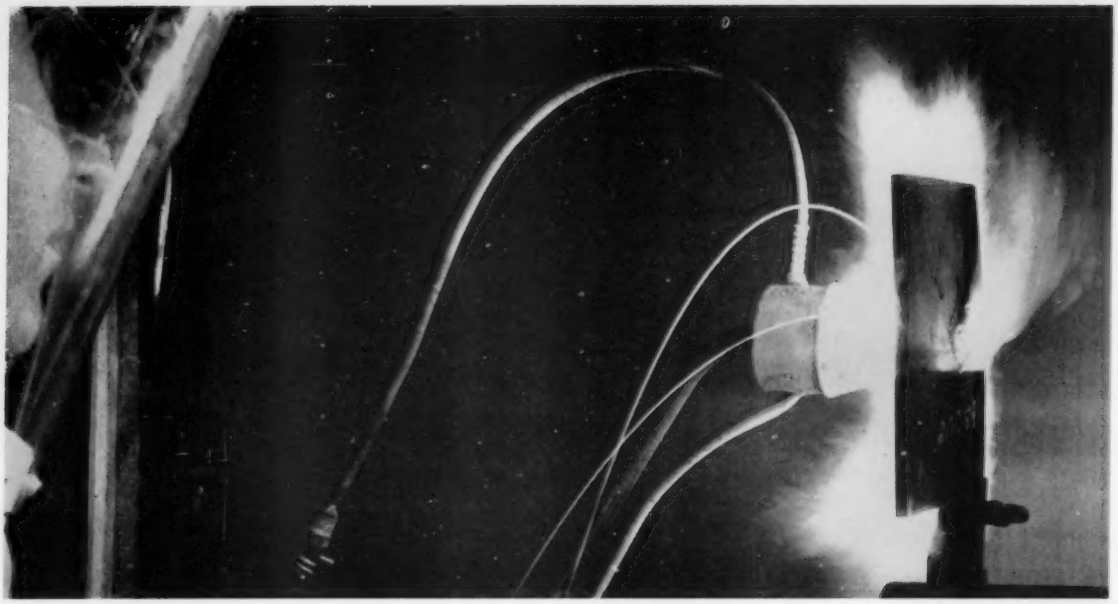


Artificial mastoid developed at Beltone Research Labs aids calibration of bone conduction (sound reception through the mastoid) in audiometers and hearing aids.

This antenna pattern range at Wichita Div. of Boeing Airplane Co. is capable of rotating 350-lb. models to study antennas for high-speed aircraft.



I-T-E Circuit Breaker Co. has established a new test range at Trevose, Pa., to handle giant radar antennas such as this one built for use on the DEW Line.



109

New products

Laminate withstands extreme heat 109

A new grade of Dilecto laminated plastic is being developed for use in missiles and other applications that require exceptional heat resistance. Made by impregnating graphite fabric with a heat resistant phenolic resin, the material is now known as CDF lab designation N-104-84-2. In laboratory ablation tests, a 6-inch square by ¼ inch sample of this new laminate was exposed to a 5000 deg. F. flame. It required more than 10 minutes to burn through the sample, giving it a burn-through rate of less than 0.0005 inch per sec. Typical burn-through rates for other materials are: 0.0017 inch per sec. for phenolic impregnated high silica glass; 0.002 to 0.003 inch per sec. for phenolic impregnated felted asbestos and 0.004 inch per sec. for phenolic impregnated glass cloth laminates.

Continental-Diamond Fibre of Canada Ltd., Toronto.

Alternative transmission facility 110

The Rogers Majestic broad band series of equipment operating in the 152-174 mc frequency band, or alternately 132-144 mc, is designed to provide a suitable transmission facility, as an alternative to open-wire or cable lead, for short-haul systems from which voice, signalling, alarm, telemetering and control channels can be derived. Originally designed for single hop circuits up to 40 miles in length, several such links have been operated in tandem for a complete chain. Some of the equipment features are: 50-watts power output; continuous duty; baseband will accommodate up to six voice channels; built-in metering facilities.

Philips Electronics Industries Ltd., Toronto.

Low frequency oscillator 111

Elin low frequency oscillator model AM216-4R will supply any one of four preset output frequencies in the range 20 to 400 cps. Output selection may be made remotely by energizing one of four 28 vdc relays or manually (for initial setup) by a switch mounted behind a hinged door in the front panel. Also located behind this door are three pairs (coarse and fine) of frequency adjustments and an output voltage adjustment. The oscillator supplies 26 volts unbalanced output at 52 ma within the above stated frequency ranges.

R-O-R Associates, Ltd., Don Mills, Ont.

Bernoulli-disk magnetic drum 112

Applying a principle discovered by the Swiss scientist Daniel Bernoulli, scientists of the Computor Products Div. of Laboratory for Electronics, Inc., have produced a magnetic memory device for use with missiles, aircraft and other applications having severe environmental conditions. The device consists of a thin disk of mylar magnetic material rotated close to a smooth stabilizing plate in which the read/write heads are imbedded. When stationary, the limp disk falls away from the plate, but when rotated, air is pumped in to the centre of the plate and out between the plate and the disk. The combination of the centrifugal force of the whirling disk and the hydrodynamic forces of the air maintains a precise and controllable separation between the disk and the plate. The Bernoulli-Disk is a practical, low-cost, self adjusting device that can be used in almost any system where a magnetic drum is conventionally employed. It will meet the shock and environmental requirements of missiles and satellites, and has extremely low power requirements.

Electromechanical Products, Agincourt, Ont.

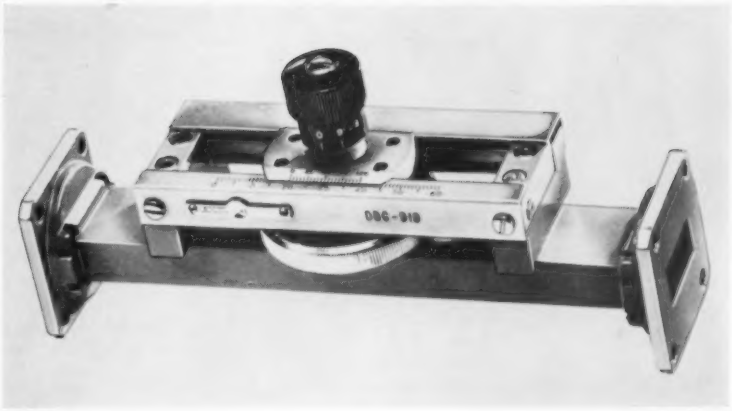
Constant current power supply 113

John Fluke model 351A rack mounting power supply is a general purpose precision laboratory instrument with a wide range of applications. It is adjustable in one microampere increments and provides regulation to better than 0.01% with an output of 0 to 100 ma, at a maximum of 100 volts. Long term stability is 0.01%, assured by the use of chopper stabilization against a standard cell reference. Calibration of current measuring instruments is accomplished to an accuracy of 0.05%.

A feature is the voltage limiter circuit which can be switched in or out from the front panel. This limits the voltage across the output terminals to 600 mv

114

115



116

For further information on New Product items, use the Reader Service cards on pages 67 and 68

when the load circuit is opened. This arrangement permits meters or other loads to be changed without switching the supply to stand-by and ensures against destructive overvoltages being applied across the load accidentally.

Allen Crawford Associates, Willowdale, Ont.

Dual level battery 114

A new, dual battery in a single case provides auxiliary power for missiles and space vehicles. Two battery sections in the model P46A provide for a heavy peak current demand as well as a steady power supply for equipment with non-fluctuating requirements. A 20-cell section provides a current of 25 amperes at 28 volts. Maximum current is 100 amperes with a discharge time of 35 minutes at 25 amperes. Capacity is 15 ampere-hours.

The second 4-cell section supplies 6.3-volts at 19 amperes. Maximum current is 100 amps with a discharge time of 35 minutes at 19 amps. Capacity is 11 ampere-hours.

Cook Batteries, Denver, Colorado.

Hermaphrodite power connector 115

This non-reversing hermaphrodite power connector automatically mates with any other of its kind without regard to which end is which. Each unit is both a plug and a socket at the same time. Threaded collar lock prevents joined units from being separated accidentally. It has a power rating of up to 100 amps. 440 volts ac, and is suitable for two, three or four-wire cables. Only one solder connection is necessary for each conductor. Built-in safety ground contacts mate before any power contacts are mated. Both cable and panel types are available.

Specialty Electronics Development Corp., Syosset, N.Y.

Variable stub tuners 116

A line of precision variable stub tuners covering the frequency range 2.6 kmc to 90 kmc has been introduced by De-Mornay-Bonardi. Units in the range of 2.6 to 18 kmc are equipped with calibrated position controls for both insertion and probe travel. A new scale and vernier provide precise resettability on longitudinal travel, and a new micrometer scale on the probe supplies accurate measurement of penetration. The probe support has a dissipative insert which eliminates radiation effects. VSWR as high as 20:1 can be tuned out with 1.02 accuracy.

Units in the 18 to 90 kmc range are designed for accuracy in these higher frequencies. In addition to the above features the high range tuners have micrometer positioning which provides readability to 0.0001". Threaded holes in these instruments provide for direct attachment to waveguide supports.

Bayly Engineering Ltd., Ajax, Ont.

Miniature potentiometers 117

A matched series of rugged, moisture-resistant miniature precision multi-turn potentiometers designated types 5000, 7500 and 1000 measure ½, ¾ and 1-inch diameter respectively. Resistance values range from 50 to 350 k, and linearity tolerances range down to ± 0.075%. Housings are of nickel-plated brass, and terminal headers are of molded diallyl phtalate.

Renfrew Electric Co. Ltd., IRC Division, Toronto.

(Continued on page 56)

People—continued

Engineering and sales appointments

A. D. Burford, P.Eng., has been appointed to direct the sale of Ward Leonard of Canada Ltd. range of electrical and electronic products. Mr. Burford was formerly associated with Amalgamated Electric and has been product sales manager since 1956.

MILNE STUDIOS

Burford

CARPENTER

Mainguy

Taylor

ANDERSON & COLE

Bishop

W. N. K. Mainguy has joined R-O-R Associates as a field engineer at the Montreal office of the company. Mr. Mainguy is a science graduate of Sir George Williams College, with a major in mathematics and physics. He has served with Canadair Ltd., and Sperry Gyroscope Company of Canada Ltd.

N. W. Taylor has been appointed assistant-to-the-president, Linde Company. Mr. Taylor is a graduate of the University of Toronto and was a member of the Canadian team in the 1924 Olympic Games.

Robert E. Bishop has been appointed mobile radio sales representative for Canadian General Electric Company in eastern and south-western Ontario. Mr. Bishop was born in London, Ont., and joined the company in 1953 following five years' service with the communications branch of the Royal Canadian Navy. He has been employed on communications and radar installation work, and recently supervised microwave maintenance for CGE.

Two new sales department positions have been created at Philco Corporation of Canada Ltd. **F. Womersley** has been appointed manager of distributor operations, and **H. C. Bell** has been appointed manager of contract sales.

Ian J. Main has been appointed sales manager for the dealer products department of Dominion Electrohome Industries Ltd. Mr. Main is a graduate of the University of Western Ontario and has been in sales with Electrohome for the past six years.

Canadian Westinghouse Co. Ltd. has appointed **S. P. Burden** Ontario region sales manager, responsible for co-ordinating all sales and service of the company's appliances, television, radio and high fidelity products to dealers in the Ontario region.

Keith W. Allen has been promoted to special markets manager of Polaroid Corporation of Canada Ltd. He will be responsible for management of the company's industrial sales activities.

Reports—continued

Ampex forms new company in Canada

James E. Detlor, Manager, Ampex American Corporation, has announced the formation of a new company — Ampex of Canada Limited — to market the complete range of Ampex magnetic tape recording products in Canada. Marketing of Ampex Videotape television recorders and other video products will be conducted from the new firm's headquarters at 1458 Kipling Avenue North, Rexdale, Ont., under the direction of Mr. Detlor. Digital and analogue data recorders will be marketed by the Instrumentation Division, headed by Thomas Dalzell, in the Commonwealth Building, Ottawa. Ampex professional audio recorders and home music systems will continue to be sold by appointed dealers throughout Canada.

The new Canadian company is a subsidiary of Ampex International S.A., of Fribourg, Switzerland, which was formed recently to manufacture or market Ampex products outside the United States.

Marconi sells doppler radar to Irish Airlines

Irish Airlines has bought nine Canadian-designed doppler radar navigation sets for its new transatlantic jets. Worth some $155,000, this is the third major airline order won by Canadian Marconi Co. The company also expects to make further civil and military sales.

New representatives and principals

Houston Instrument Corp. of Houston, Texas, has appointed **B. H. McGregor, P.Eng.,** as Canadian representative for their recorders and amplifiers. Mr. McGregor, formerly with A. C. Wickman Ltd., has established his own company. It is B. H. McGregor, Box 156, Station "H," Toronto 13, Ontario, telephone OX 9-5521.

Rudel Machinery Co. Ltd., Montreal, has been appointed exclusive Canadian sales representative for precision electronic welding equipment manufactured by Weldmatic Div. of Unitek Corp., Monrovia, Calif.

Found Brothers Aviation, Ltd., Malton Airport, Malton, Ontario has been appointed sales representative in Ontario and Quebec for Burnell & Co. (toroids, filters, networks).

Constellation Components Co., Scarborough, Ont., and Pierrefonds, Que., are now exclusive Canadian representative and distributor for Linemaster Switch Corp., Woodstock, Conn. (footswitches).

New plants and offices

Thermovolt Instruments Ltd. has recently moved into its new plant at 70 Advance Road, Toronto 18. Situated on one acre of land for future expansion, the 7,000 square foot plant incorporates manufacturing, engineering and service departments.

Veeder-Root of Canada, Ltd., will locate its new sales and service centre at 28 Fieldway Road, Toronto. These operations are being transferred from headquarters in Montreal to be closer to the main market for the company products. Daniel J. MacDonald has been promoted to the position of manager of the Toronto office.

Federal Wire and Cable Division of H. K. Porter Co. (Canada) Ltd. has opened warehouse facilities at 34 Albert St., Moncton, N.B., to carry a complete stock of wires, cables and magnet wire.

Investment house installs data processing centre

Merrill Lynch, Pierce, Fenner and Smith brokerage firm is going to install an IBM 7080 electronic data processing system to process its stock transactions. The Toronto office of Merrill Lynch will be among the 130 world-wide branches of the firm feeding information into the machine at the New York head office. The brokerage house has 440,000 active accounts which produce more than 20,000 trades daily.

Trades wired into Merrill Lynch's New York headquarters from U. S. offices and overseas branches will be fed into the 7080 and computed at the rate of more than 1,000 a minute. This will speed the preparation of confirmations which are wired back to the branches.

CAMESA News

This bulletin has been prepared for CEE by the Canadian Military Electronic Standards Agency, Ottawa. Watch for more news of Standards and Specifications in future issues.

A new edition of Standardization Bulletin SB-1, dealing with the conditions and procedures for qualification approval of electronic parts will be issued in April, 1960. Procedures have been revised to emphasize aspects of quality control and availability of test equipment at the plant of the part manufacturer. The procedures for mutual recognition of qualification approval between the United States and Canada are included.

Specification MIL-C-11015B covering Fixed, Ceramic, General Purpose Capacitors has recently been issued by CAMESA. This specification supersedes specification MIL-C-11015A and incorporates the following changes:

(a) Three operating temperature ranges are now included: —55 to +85C, —55 to +125C and —55 to +150C.
(b) The capacitance change requirements for the voltage temperature limits have been tightened.
(c) Three capacitance tolerances are now available.
(d) Requirements have been tightened for the following tests: Barometric Pressure, Insulation Resistance, Power Factor, Temperature and Immersion Cycling, Moisture Resistance and Life.
(e) Terminal Strength and High Frequency Vibration tests have been added.
(f) Six new styles have been added.

Specification MIL-F-19207 (Ships) covering Extractor Post type Fuse Holders has recently been issued by CAMESA. This specification covers fifteen types of fuseholders designed for use with MIL-F-15160 type fuses.

Specification MIL-C-25B covering fixed DC Paper Capacitors hermetically sealed in metallic cases is now in the final draft stages. This specification introduces two vibration grades for paper capacitors: 10-55 cps and 10-2000 cps. In addition, some of the test requirements of MIL-C-25A have been modified. It is expected that this specification will be issued by CAMESA in the near future.

Specifications for four styles of dipped Mica Capacitors are in the draft stage. When completed these specifications will be used in conjunction with MIL-C-5B.

Specification MIL-C-17C covering Radio Frequency Coaxial Cables has recently been issued by CAMESA. This specification introduces new dielectric constructions and jacket materials in addition to new test requirements. Manufacturers of RF Cable holding Qualification Approval to MIL-C-17B have been requested to arrange for the additional testing required to establish qualification approval of their product under the new specification.

Electron devices

In the near future specification MIL-T-19500 will be superseded in Canada by specification MIL-S-19500. The latter covers semiconductor diodes as well as transistors, whereas the former covered only transistors. The process of re-issuing existing diode specifications to bring them within the scope of MIL-S-19500 will be gradual.

The first issue of a NATO Guidance List of Transistors has been agreed by the responsible technical group.

Bruel & Kjaer R.M.S. Voltmeter

SIX INSTRUMENTS IN ONE

1. True R.M.S. meter
2. Peak responding meter
3. VU meter
4. DBM meter
5. O-60 DB amplifier
6. Built-in A.C. reference

One compact instrument, the Bruel & Kjaer Type 2409 Voltmeter, provides **ALL** the functions listed above.

Weighing only 10 lbs. with 10" x 7" x 5" dimensions, model 2409 has response from 2 to 200,000 cps ± 0.2 db. Full scale ranges from 10 mv to 1000 v with 10 megohms input resistance.

The instrument can be switched to read average, peak or true R.M.S. values. Two damping characteristics are provided, one in accordance with standard VU meter requirements and the other highly damped for low frequency work.

As an amplifier, model 2409 has 60 db gain, 50 ohms output impedance, less than 0.2% distortion, and 20 microvolts internal noise.

The meter face is illuminated and in addition to voltage scales, has DBM scale (0 DB = 1 mw in 600 ohms) and DB scale referenced to 0 DB at 1v. Built-in Zener diode A.C. reference.

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For your library

Text provides advanced theory of solid state physics

Elements of Solid State Theory

G. H. Wannier; (Cambridge University Press) The Macmillan Company of Canada Ltd., Toronto; 270 pp; $6.

Reviewed by J. H. Simpson, Radio and Electrical Engineering Division, National Research Council, Ottawa.

This book is described by the author as "an attempt to provide a coherent and brief outline of the theory behind present-day solid state physics, aimed at advanced students or scientists with good all-round knowledge." In this reviewer's opinion the attempt has met with considerable success. The book should not be regarded as an introductory textbook and is complementary to, rather than competitive with, works such as Kittels' "Introduction to Solid State Physics." Engineers or industrial physicists who hope to acquire a knowledge of the physics of the materials they are using would be well-advised to start with a book of the latter type. However, when the introductory phase has been passed and the student is capable of a better over-all grasp of the subject, it is desirable to have a book that treats the subject on a general basis and discusses subtleties that are beyond the range of the less advanced reader. Wannier's book seems to fall in this category. It confines itself to the main branches of solid state physics and treats them from a broad and fundamental point of view. Many subjects that would be treated in detail in an elementary text are taken as known and this has enabled the author to include recent developments in a book of relatively small size. Many of the references (e.g. in the discussion of semiconductors) deal with work done in the middle 1950s.

The subject matter covered ranges from an interesting outline of the geometry of the crystalline state, through diffraction effects and an outline of lattice dynamics, to theories of co-operative phenomena, electron bands, bound carriers states and carrier dynamics in semiconductors, and solid cohesion.

The reviewer's opinion may be summarized by saying that the book is a well-written, interesting and up-to-date account of the more important branches of solid state physics. It will probably be of greatest interest to physicists of a theoretical turn of mind who have a knowledge of quantum mechanics and statistical mechanics and have taken an introductory course in solid state physics. Such readers cannot fail to be stimulated by Dr. Wannier's approach in which quite advanced phases of the subject are introduced almost casually but in a way which whets the appetite for further study.

An Introduction to Electronics for Physiological Workers

Second Edition; I. C. Whitfield; The Macmillan Company of Canada Ltd., Toronto; 263 pp; $3.

Reviewed by C. F. Pattenson, Radio and Electrical Engineering Division, National Research Council.

Dr. Whitfield has written this book as an introductory text to electronics and electronic circuitry for graduate students and others interested in electrophysiological techniques. The book is intended to fill the gap between the elementary text on radio, and the more advanced accounts of applications of electronics in biological research.

Starting with an account of basic electronic theory, the author goes on to deal with vacuum tube amplifiers, power supplies and waveform generators, in each case with emphasis on their interest to the biologist. Good use is made of quantitative examples and each chapter ends with several references for further reading. The last two chapters deal with semi-conductors and transistors, and transistor circuitry. It is perhaps unfortunate that a section on transducers was not included in the book, as a treatment of these devices would have been of interest to those interested in physiological measurements.

Publishers' new releases

Encyclopedic Dictionary of Electronics and Nuclear Engineering

R. I. Sarbacher; Prentice-Hall, Inc., 34 Davidson Road, Aurora, Ont.; 1,400 pp; $35.00.

This encyclopedic dictionary contains over 14,000 entries with 1,400 illustrations and 17,000 cross-references. It has assembled all the standard definitions approved by the various technical societies. It encompasses physics, electronics and nuclear engineering. It deals with communications, radio, television, aeronautical radio and radar, sonar, guided missile electronics, nuclear engineering and many others.

(Continued on page 54)

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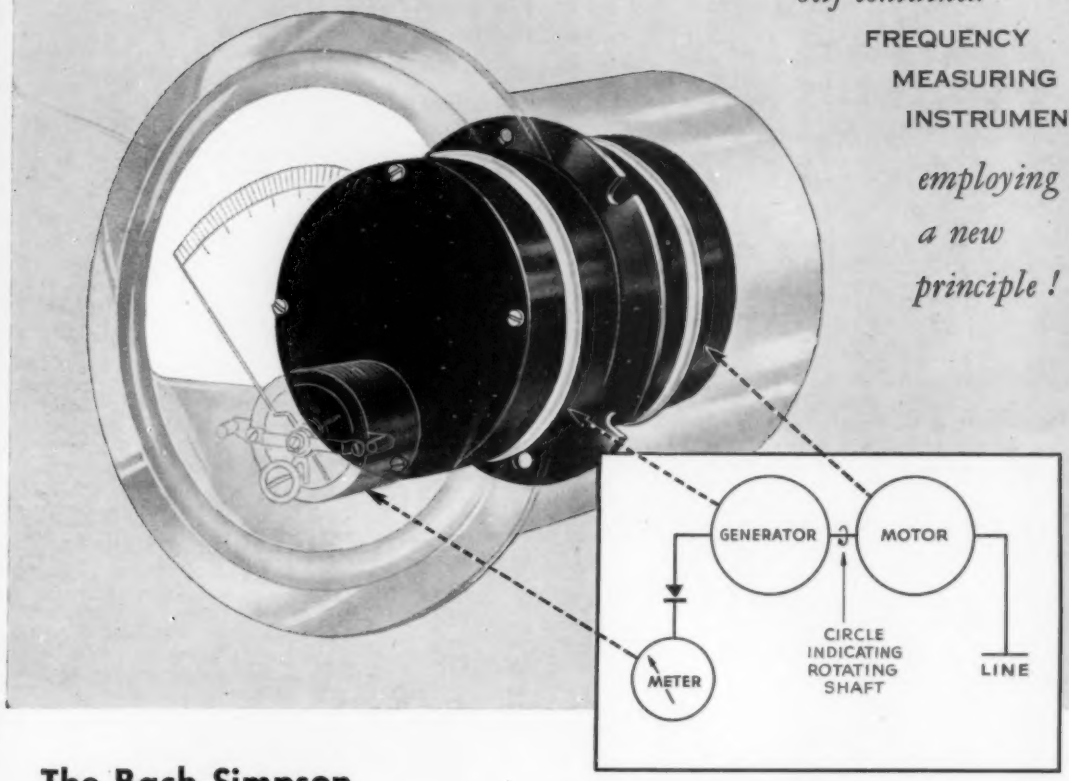

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Simple in principle, revolutionary in design, the Bach-Simpson Frequency Meter offers these advantages:

★ **INDICATION INDEPENDENT OF VOLTAGE:**
On 110 volt models, for example, input voltage fluctuation between 20 and 200 volts produces no change in indication.

★ **INDEPENDENCE OF WAVE-FORM VARIATION:**
The change from pure sine-wave to square-wave is barely detectable.

★ **COMPACTNESS:**
The miniaturised Motor-Generator which is the heart of the instrument allows a remarkably shallow self-contained unit, with simple two-terminal connection.

★ **LOW POWER INPUT:**
Less than one-half the power input necessary for most pointer type frequency meters is required.

★ **LONG TERM ACCURACY:**
The requirements of the A.S.A. Specification for Grade I Frequency Meters will be met and exceeded throughout the life of the instrument, which, under normal conditions, will be in excess of ten years of continuous operation.

★ **ECONOMY**
Extremely competitive pricing derives from the simplicity of design, and from the elimination of costly and cumbersome accessories.

How does it work? The input voltage drives a synchronous AC Motor and Generator on a common shaft, and the resulting output voltage, proportional to input frequency, is read out on a suppressed zero linearly-scaled meter.

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- **HI-POWER** *Mobile units with the equivalent power of a conventional base station.*
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Library — continued

Television luminance signal standard

A standard developed by IRE and approved by the American Standards Association describes methods of measuring the significant amplitude levels of a monochrome or color television signal, either composite or noncomposite. Designated C16.31-1959, American Standard Method of Measurement of Television Luminance Signal Levels, it is available at 60c a copy from the American Standards Association, Dept. PR 108, 70 East 45th Street, New York 17, N.Y. (IRE designation is 58 IRE 23, S1, replacing Part 1 of standard 50 IRE 23, S1.)

Transistor Circuits

K. Cattermole; Imported by Brett-Macmillan Ltd., Galt, Ont.; about $14.00.

A full coverage of one of the fastest-growing fields of electronics. The book provides information on the properties and design formulas of circuits.

Acronyms Dictionary

Gale Research Co., 34th Floor, Book Tower, Detroit 26, Michigan; 192 pp; $10 (U. S.).

This is a guide to alphabetic designations for associations, societies, non-profit organizations, international organizations, government agencies, United Nations agencies, business firms, colleges and universities, aerospace and electronic equipment and terms, transport facilities, military terms and general terms. It has 12,000 listings.

Soviet physics journals

A number of leading USSR physics journals are being printed in their entirety in English by the American institute of Physics. Four journals of interest to electronics engineers are Solid state ($55), Acoustics ($12), Technical physics ($55), and Journal of experimental and theoretical physics ($75). All prices are for annual subscription; single copies are available and reduced rates may be obtained by libraries and non-profit academic institutions. Send orders and enquiries to American Institute of Physics, 335 East 45 Street, New York 17, N.Y.

The contact modulator

This technical series on choppers is now complete through Part 6. The various parts are titled: Why use choppers, Definitions and measurement, Modulation methods, Applications and performance, Noise in chopper circuits, and Chopper amplifier design. Each part is bound separately into a booklet of about 25 pages. Copies may be obtained by writing Airpax Electronics, Inc., Combridge Div., Jacktown Road, Cambridge, Maryland.

Airpax technical journal

This periodical is devoted to the study and theory of electronic components and systems. Issues may be obtained by writing Airpax Electronics, Inc., Seminole Div., Fort Lauderdale, Florida.

Defence contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parentheses indicates the number of contracts, the amount being the total value.

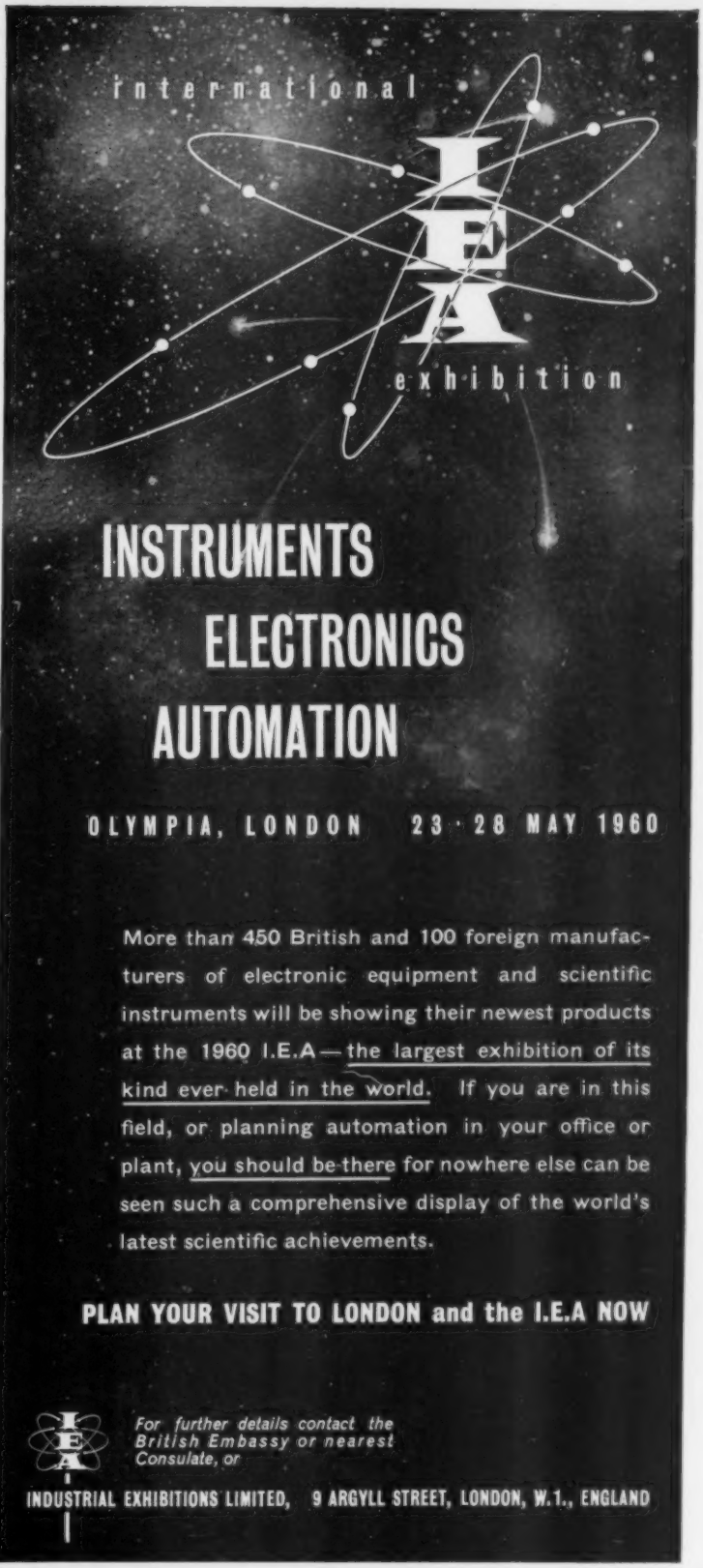
February 1 - 15, 1960

- Ahearn & Soper Co. Ltd., Ottawa, equipment, $11,328.
- Ampex of Canada Ltd., Ottawa, equipment, $25,233.
- Andrew Antenna Corp. Ltd., modification kits, $15,517.
- Canadian Arsenals Ltd., Ottawa, radar equipment, $283,707; electronic equipment, $145,452.
- Canadian General Electric Co. Ltd., Toronto, components, $14,480.
- Canadian Marconi Co., Montreal, tubes, $320,908.
- Canadian Westinghouse Co. Ltd., Ottawa, tubes, $70,570.
- Computing Devices of Canada Ltd., Ottawa, aircraft navigational aids, $500,000; course selector indicators, $23,400.
- Hart Battery Co. (1957) Ltd., St. Johns, Que., batteries, $11,935.
- Honeywell Controls Ltd., Toronto, automatic flight control systems, $1,600,000.
- Instronics Ltd., Stittsville, Ont., radar test sets, $17,820.
- Philco Corp. of Canada Ltd., Don Mills, Ont., technical services, $10,000.
- Plessey Co. of Canada Ltd., communication equipment, $4,970,291.
- Railway & Power Engrg. Corp. Ltd., Montreal, aircraft instruments, $1,658,561.

February 16 - 29, 1960

- Ampex of Canada Ltd., Ottawa, communication equipment, $20,543.
- Bach-Simpson Ltd., London, Ont., aircraft instruments, $10,093.
- Canadian Applied Research Ltd., Toronto, technical services, $22,000.
- Canadian Arsenals Ltd., Ottawa, repair and overhaul of equipment, $10,000.
- Canadian General Electric Co. Ltd., Toronto, components, $17,932.
- Canadian Marconi Co., Montreal, tubes, $73,819 (2).
- Collins Radio Co. of Canada Ltd., Toronto, components, $27,027.
- Dictaphone Corp. Ltd., Ottawa, communication equipment, $11,060.
- Raytheon Canada Ltd., Ottawa, tubes, $72,430.
- Renfrew Electric Co. Ltd., Toronto, establishment of qualified source for the manufacture of metallic film resistors, $29,330.
- Rogers Electronic Tubes & Components, Toronto, components, $11,922.
- Silvercel of Canada Ltd., Toronto, batteries, $168,000.

April is Cancer Control Month
"Fight Cancer with a Check-up and a Cheque"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DATA TRANSMISSION and TELEGRAPH TERMINALS

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Is being used with satisfaction by Railroads, Pipe Lines, Telephone Companies, Toll Highways, and Public Utilities throughout the world.

Radio Frequency Laboratories offers a complete line of models which are available with various features included to insure lowest possible cost to the customer for a given installation and application. Therefore, he is never penalized cost-wise for equipment features not desired or required.

The equipments are extremely versatile and, therefore, may be utilized in practically all data transmission and telegraph applications. A number of accessory equipments are available such as electronic and relay repeaters, party line keyers, DC hybrids, etc., to insure system compatibility.

MODEL 995

Low cost frequency shift telegraph terminal including all essential controls, power supplies and utilizes printed circuit modules.

The Model 995 is an all electronic terminal designed for data transmission and telegraph applications at speeds up to 100 wpm. The equipment comes complete with all necessary filters, equipment and loop power supplies and is available packaged as either a single or dual unit. Fourteen 100 wpm channels are available from 765/2975 cps.

MODEL 1601C

Data Transmission and Telegraph Terminal featuring plug-in frequency determining components, jack fields, and high speed circuitry.

The Model 1601C retains all the features of the Model 995 and offers the additional advantages of a carrier and loop jack field accessible through the front cover and plug-in frequency determining components. Channel arrangements are available to permit operation of either eighteen 100 wpm, twenty-five 75 wpm, or six 200 wpm channels between 400 and 3300 cps.

MODEL 1220

Completely transistorized Terminal temperature stabilized for long life, reliable service at reduced power requirements.

The Model 1220 retains the essential features of the Model 1601 but is a completely transistorized unit which may be operated directly from batteries with very low current drain or normal AC power facilities. The equipment is completely modular in design and accessory jack fields, power supplies, and front panels are available as required.

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For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

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RFL Radio Frequency LABORATORIES, INC. Boonton, New Jersey, U.S.A.

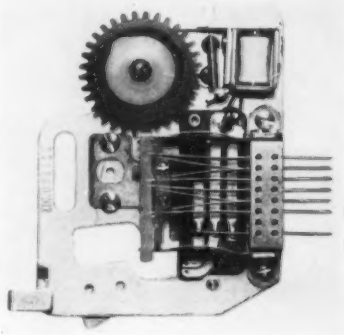
For further information mark No. 40 on Readers' Service Card

New products — cont.

Electro-mechanical logic switches 118

These electro - mechanical logic switches and decimal counters for use in large and small data handling systems, computers etc, feature fixed state stability, short term switching response delay, multiple set contact arrays, repeatable operate and drop-out times and complete separation of switching elements. All units have a common means of communication.

Three basic elements are combined in each switch — a delay element, a bi-stable element, and a number of AND gates associated either with the assert or negative side of the bi-stable element. The manufacturer furnishes switches and counters separately, or packaged in various units such as shift registers, translators and verifiers.



Tally Register Corp., Seattle, Washington.

Electron microprobe analyzer 119

This electron microprobe analyzer excites X-radiation from elements in a volume of a few cubic microns on the surface of a sample. Effective focus is of the order of 2 microns diameter when measured in zirconium at 25 kv. The instrument is designed to analyze all elements from magnesium #12 up in the atomic table. Accelerating voltage is adjustable in 5 kv steps through a range from 10 to 50 kv. Sensitivity permits X-ray emission analysis of 0.1% concentrations of elements #24 (chromium) to #42 (molybdenum) in a zirconium matrix when the sample is excited by electrons at the electron focus.

The microprobe analyzer electronic system includes three complete counting channels; two for use with Geiger counters, and one with scintillation or flow proportional counter for high capacity counting. High voltage power supply for counter has independent controls covering the 1,400 to 2,100 volt range. One additional control handles the 700 to 1,400 volt range for the scintillation counter. The rate meter operates on three circuits and covers a range from 0 to 100 counts per second. The scale selector uses decades for 0 to 10^3, 0 to 10^4, and 10^5. Time constants are ½, 1, 2, 4 and

8 seconds; accuracy is 1% and manual switches turn the rate meters on and off. Included are three 5-in. recorders.

Philips Electronics Industries Ltd., Toronto.

Stereo tape recorder 120

Concertone model 505 tape recorder plays both two-track and four-track tapes. For two channel stereo and half track monaural playback, a two-track stereo playback head is used. For 4-track stereo, at either 7½ ips or 3¾ ips, a second playback head designed for slow speed, quarter track tapes is used. Separate record and playback heads permit instant monitoring of the taped signal. Model 505 can record two-channel stereo or monaural half track. Each channel has separate line and microphone controls with provision for mixing. The erase head can be turned off for dubbing. Frequency response is ±2 db from 50 to 15,000 cps at 7½ ips; ±2 db from 50 to 10,000 cps at 3¾ ips. Signal to noise ratio is —50 db. Starting and stopping time is 0.5 seconds. Flutter and wow are less than 0.2% rms at 7½ ips; less than 0.25% rms at 3¾ ips.

Len Finkler Ltd., Toronto.

Ceramic i-f filters 121

These new ceramic i-f filters are designed to replace conventional mechanical filters in radio and television sets. They are available in many different electrical values so that set producers may use these devices in their circuitry. They can be used in place of a transformer and associated components such as resistors and capacitors.

U. S. Sonics Corp., Somerville, Mass.

Aluminum nameplates 122

Boeing Airplane Co. Metal-Cal anodized aluminum nameplates and decorative finishes are now being manufactured in Canada. Names, instructions, diagrams or designs are etched into the surface making smudging or fading impossible. A choice of five adhesives are available depending upon application. The nameplate comes in eight colors allowing versatility of design.

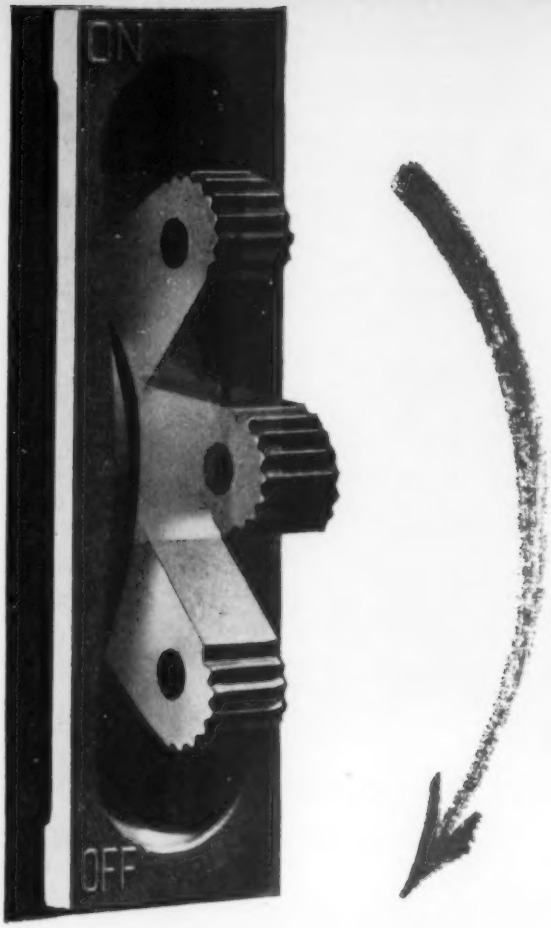
Jonergin Co., Inc., Verdun, Que.

Ceramic capacitor 123

A high-temperature ceramic capacitor about twice the size of a pin head with values to 100 pf has been developed by Vitramon, Inc., for use in encapsulated circuits. Called the VK-U series, these capacitors are designed for operation from —55 deg.C. to +150 deg.C. at 200 vdc without derating. Other members of the same family offer values to 10,000 pf in a progression of sizes to a maximum of 0.265" sq. x 0.070" thick. All units are guaranteed a minimum life of 1000 hours at maximum temperature and 200% of rated voltage after encapsulation.

Aeromotive Eng. Prods., Montreal.

(Continued on page 58)



NEED A MANUAL POWER SWITCH THAT CAN BE ELECTRICALLY TRIPPED?

HEINEMANN HAS IT

Applications are popping up all over for this popular variation on the circuit breaker. It seems that there's nothing that quite fills the same bill.

For want of better terminology, we've called it an electrically-tripped power switch.

First, it's a manual remote switch. Second, it can be electrically turned "off" by a remote contact . . . a timer, an interlock circuit detecting malfunction or an overload condition.

"A switch" to the layman, this specialized breaker is everything to the designer looking for simplicity (switch and lock-out relay in one), interrupting capacity (2000 amperes at 125 V., AC), compactness and low cost.

Typical applications include timing cut-off on an every-day copying machine; malfunction shut-down of a popular bowling pin spotter.

If you have any product that should be switched "on" or "off" manually . . . and tripped "off" electrically . . . you should know more about this Heinemann product.

Send for complete data; request Bulletin 3201.

HEINEMANN ELECTRIC COMPANY **166 Plum Street, Trenton 2, N.J.**

B.A. 2107

For further information mark No. 25 on Readers' Service Card

MUIRHEAD

GEARHEADS

Backlash after 500 hours' running! Less than 45 mins.

These gearheads are designed to mount on the front of standard Bu-Ord, SAE, and RAE size 11 motors, and can accommodate the different shaft lengths of these types. They have the same overall diameter and mounting arrangements as the motors to enable them to be mounted in a similar manner. Types are available modified for use with size 08 or size 10 motors, or on their own as speed reducers. In the design particular attention has been paid to robust construction and long life, ball bearings are used throughout and the materials and dimensions of the gears have been chosen to give minimum amount of wear.

PERFORMANCE SPECIFICATION

INPUT. The input gear meshes with the 13 tooth 120 DP. pinion of either standard Mark 14 motors, size 11 motors to SAE ARP. 497 or size 11 motors to RAE, EL, 1789. OUTPUT. The standard output shaft is splined 21 teeth 120 DP. with thread for shaft nut and drive washer. Alternatively plain shafts up to $\frac{7}{16}$" diameter may be supplied, or a 13 tooth 120 DP. pinion suitable for cascading 2 or more gearheads.

Maximum power output, torque not to exceed 80 oz in	$\frac{1}{4}$ watt
Maximum backlash after 500 hrs running with $\frac{1}{4}$ watt load	45 minutes measured on output shaft by reversing 8 oz in torque
Starting torque	0 2 gm cm
Inertia at motor shaft	0.02 g cm^2
Operating temperature range	—54°C to + 100°C
Tropical exposure test DTD 1085B	Withstands 28 days exposure

RATIOS. A number of ratios up to 600:1 are available as standard and these will probably satisfy most requirements:—Types G11A, 600:1; G11B, 300:1; G11C, 150:1; G11D, 60:1; G11E, 24:1; G11G, 40:1. Other ratios can be provided.

MUIRHEAD

Precision Electrical Instruments

MUIRHEAD INSTRUMENTS LIMITED, Stratford, Ontario, Canada
Telephones: 3717 & 3718

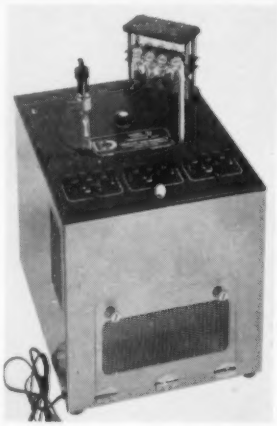
497

For further information mark No. 32 on Readers' Service Card

New products — cont.

Constant temperature oil bath 124

Weston Instruments has developed a highly regulated, controlled temperature bath designed to maintain a bank of 12 standard cells at a constant temperature, ± 0.01 deg. C. In operation, standard cells are immersed in a tank of neutral oil, and the oil temperature is maintained throughout the volume at 35 deg. C. by a circulating system. The polyethylene tank is insulated to minimize heat loss, and a glass-mercury thermometer graduated in increments of 0.02 C. per division provides visual indication of the oil temperature. The new bath, designated model 66, can maintain output variation



of standard cells to 0.5 microvolt. The bath operates on 115 volts 60 cps, 300 watts. Tank capacity is 5 gallons requiring approximately 4 gallons of oil for proper operation.

Daystrom Ltd., Toronto.

Static inverters 125

This static inverter changes dc to a square wave ac which will drive motors directly without the need of an output transformer. Although weighing only 3 oz. with a total volume of just over 2½ cubic inches, model P303 is capable of supplying 60 watts of power at an efficiency over 90%. Basic unit operates from 28 vdc with an output frequency of 400 cps.

Westamp, Inc., Los Angeles, Calif.

Double-turret terminal 126

Double-turret, Teflon press-fit terminal No. 2610 is designed to press fit into a hole 0.136 inch ± 0.002 inch diameter in panels from 1/32 inch to ⅛ inch in thickness. They may be used wherever conditions of extreme humidity and low capacity to ground are encountered. Two overall lengths are available: No. 2610-6 is 0.325 inch with greatest spacing between top and middle turrets; No. 2610-7 is 0.365 inch with turrets spaced approximately equidistantly.

Cambridge Thermionic of Canada Ltd, Montreal.

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For further information mark No. 49

also available in narrow rolls for use as a mending tape for torn drawings. The mat outer surface of the film allows use of pen, pencil or typewriter and the surface takes repeated erasures.

Keuffel & Esser Co., Hoboken, N.J.

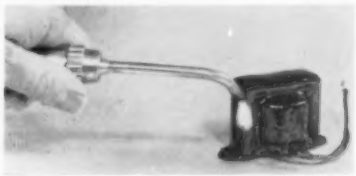
Medium range coil winder 127

Model 650-AM medium range winder for multiple winding heavy duty transformer, bobbin and field coils has been introduced by George Stevens Mfg. Co., Inc. It is furnished with selective stopping feature for transformer winding, emergency stop, instant spiral-rapid traverse, heavy duty locking tailstock, positive stopping magnetic brake, two wire guides, totally enclosed 3 hp 220/440 three-phase induction motor, one gearing setup and adjustable winding width feature. Fixed winding speed is 150 rpm with controlled acceleration attained by clutch brake unit, maximum coil OD 16 inches, maximum winding stroke 9 inches, maximum loading distance for multiple winding 40 inches, wire sizes wound 10 to 31 AWG, winding range 7 through 104 turns per inch.

Alec W. Andrews & Associates, Port Credit, Ont.

Fire retardent epoxy resin 128

Emerson & Cuming Stycast 1231 is a fire retardent resin which may be cured at room temperature. Thin sections repeatedly introduced to a flame will, on each occasion, immediately extinguish.



Due to its low thermal coefficient of expansion and high heat stability, large embedments can be made. It is stable over a temperature range of —100 to +350 deg. F. It can be color coded to specification but normally is supplied in black.

M. J. Howard & Co. Ltd., Ottawa.

Microwave step attenuators 129

Designed for use where manual operation of microwave attenuators is not practical, a new line of 6 or 12-position automatic step attenuators from Empire Devices is powered by a motor-operated driving mechanism. Actuation of a simple rotary switch, or of push buttons causes the mechanism to produce the rotary and linear movements required to insert the desired attenuation value.

Empower attenuators may be obtained in a wide range of standard values from 0.1 db to 60 db, and capable of handling 1 or 4 watts of rf power. Frequency range is from dc to 4 kmc, and standard units operate from a 28 vdc power source. Other voltages may be obtained on order.

Instronics Ltd., Stittsville, Ont.

(Continued on page 60)

ENGINEERS

Positions in Southern California

TACTICAL DATA SYSTEMS
COMPUTERS AND CONTROL SYSTEMS

Initial assignments are available in both military and non-military projects, but applicants must be capable of obtaining U.S. security clearance to qualify them for future work. You will be working for a vigorous young company, already one of the 500 largest corporations in the United States, and noted for developing, producing and delivering advanced hardware of exceptional quality.

CIRCUIT DESIGN — Digital and analog computers and associated input-output devices.

LOGIC DESIGN — Application to large-scale real-time digital computers.

CRT DISPLAY — Symbol generation, summations, deflection, and Z-axis amplifier design for display consoles.

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SWITCHING CIRCUITS — Central computer and digital display circuits using core storage, capacitor storage, and semi-conductors.

ANALOG-DIGITAL CONVERSION EQUIPMENT — Digital-shaft position, digital-DC, shaft position-digital, DC-digital.

PRODUCT DEVELOPMENT — Test, modification, and evaluation of development and prototype models of complex digital data processing and display systems.

Assignments are also available in the design of very sophisticated Inertial Guidance systems, including associated ground support equipment and special test equipment. If you are interested in working in Southern California (we assist with re-location expenses) — and have had at least 3 years of experience — write, wire or telephone Mr. J. M. Bridgman, Litton Industries, Booth Building, 165 Sparks Street, Ottawa, Ontario. Telephone Central 3-4040.

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Electronic Equipments Division
Beverly Hills, California

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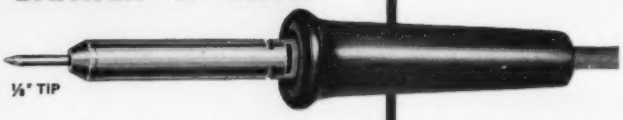
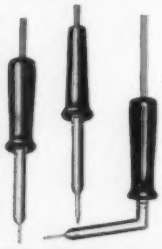
the *NEW*, American Beauty BANTAM "X" series



Designed with 50 watt input, these fine soldering irons will give greater productivity and do industry's most exacting soldering jobs easier, faster, better. SLOTTED STAINLESS STEEL CASINGS MAKE THE HANDLES REALLY COOL, ending operator complaints. There's no waiting or fumbling with these light, flexible tools — they're always ready. American Beauty soldering irons are known the world over for their dependability, durability and efficiency. Learn more about these fine soldering tools today.

Shown below are other shapes and tip-size irons available in the BANTAM "X" series.



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Starting salary, benefits outstanding; career rewards limited only by individual's capability. Send résumé, in complete confidence.

Apply Box 102,
Canadian Electronics Engineering,
481 University Ave.,
Toronto, Ont.

New products — cont.

Electronic lung 130

A new lightweight electronic lung is now available to persons with paralyzed respiratory muscles. It can replace the iron lung. Called the Barnet Ventilator, it weighs only 56 pounds and is portable. Its transistorized circuit will run from built-in batteries for twenty hours without recharging.

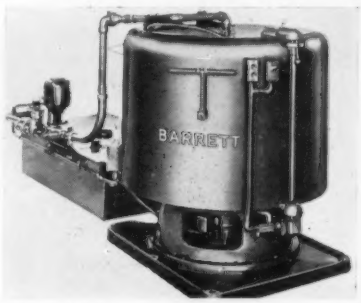
In operation the Barnet Ventilator is linked to the patient by two plastic tubes which exert positive and negative pressures, pumping air into and extracting from, the lungs.

Pye Canada Ltd., Toronto.

Component impregnator 131

The Barrett impregnator utilizes centrifugal impregnation by developing a pressure variance from 100 psi at the periphery to 0 at the centre of the chamber. Saturants such as varnish, wax, asphalt, oil or others are pushed into the objects while air and other contaminants are being pushed out. Excess impregnant on the surface can be "spun off", drained out and saved. Special models allow the use of volatile, electrolytic and hot saturants.

Leon J. Barrett Co., Worcester, Mass.



Sealant sets up without heat 132

Silastic RTV 731 is a single package silicone sealant that cures in place to a tough, rubbery solid without the addition of catalyst or heat. Primers are not necessary in achieving good adhesion to most surfaces. On exposure to air the compound becomes tack-free within one hour and sets up to a completely cured seal within 24 hours. Resiliency and adhesion remain virtually unchanged at operating temperatures ranging from -70 to 500 F.

Dow Corning Silicones Ltd., Downsview, Ont.

Screen rooms 133

This company has introduced a series of conventional, double isolated, and solid metal rooms for electrical insulation. No physical or electrical connection between inner and outer shields exists except where purposely connected at the power entry point. Each of the two

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For further information mark No. 30

shields in the double isolated rooms can be independently grounded. Doors use two rows of spring bronze contact fingers, provide separate electrical contacts with the inner and outer screens. All doors are covered with solid metal on both the doors and door jambs. Attenuations as high as 120 db from 100 kc to 550 mc are possible.

Erik A. Lindgren & Associates, Inc., Chicago.

Portable tube tester 134

Model 8-77 has been designed as a radio and television technician's portable vacuum tube tester. It checks filament voltages in 18 steps from 0.6 to 117 volts. Also tests grid current, element shorts, filament continuity, reserve cathode capacity, and dynamic mutual conductance. Readings are made directly on the 3-range (0 to 3000, 6000 to 15000) micromho scale.

Stark Electronic Sales Co., Ajax, Ont.

Computer diodes 135

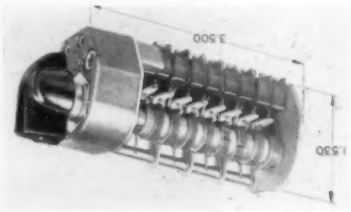
High voltage silicon mesa diodes types 1N914 and 1N916 switch from 10 ma forward current to 6 volts reverse in four nanosec maximum. They will have broad application throughout the computer industry.

This switching capability is coupled with a capacitance of only 2 picofarads (maximum). For frequencies up to 100 mc, both diodes provide a maximum rectification efficiency of 45% and have a guaranteed maximum leakage of 25 nanoamperes at 20 volts. Peak inverse voltage is 75; dissipation is 250 mw at 25 deg. C; guaranteed minimum forward voltage is 1 volt at 10 ma; operating range is —65 to + 150 deg. C; maximum storage temperature is 200 deg. C.

Texas Instruments, Inc., Rexdale, Ont.

Cock-and-fire rotary switch 136

Series 28AS rotary selector switch assemblies featuring a cock-and-fire actuating mechanism and non-tease circuitry

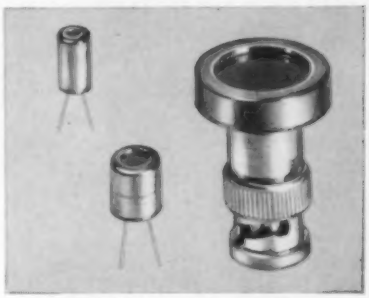


are designed for use on aircraft, electronic and computor panels. They can be provided with 2 to 8 plastic-enclosed single-pole double-throw basic switches and 2 or 3 actuator positions. Detents are 90 deg. A variety of switching sequences can be factory adjusted to fit customer requirements. Individual actuating levers pivot on a common rod, insuring maintained adjustment. Basic switch is rated for 5 amps, 125/250 vac.

Honeywell Controls Ltd., Toronto.

(Continued on page 62)

RCA VICTOR
Introduces a
NEW-TYPE ENCAPSULATED SILICON JUNCTION
Alpha Detector



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- **Optimum Geometry**
- **High Resolution**
- **Large Area Detection**

A product of the Research Laboratories of RCA Victor in Montreal, this silicon junction alpha detector is a small, rugged "solid state ionization chamber" capable of detecting individual alpha particles of energy 0.5 Mev or more. It can be used as a proportional counter over a range of approximately 1.5 to 10 Mev with excellent linearity and a resolution of better than 1% at 5 Mev. Also useful for protons, deuterons and heavy ions.

TYPE	A	B	C	D	F
Detecting Area	5mm²	5mm²	20mm²	20mm²	2cm²
Maximum Operating Voltage	50v	10v	50v	10v	25v
Resolution for 5Mev α-Particles	<1%	-	<2%	-	-

Inquiries invited: Write
Director of Research,
RCA VICTOR, Research Laboratories,
Montreal 30, Canada.

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For further information mark No. 42

Megacycle Meter

Model 59
Oscillator
2.2 Mc - 420 Mc

Model 59-UHF
Oscillator
420 Mc - 940 Mc

Model 59-LF
Oscillator
100 Kc - 4.5 Mc

Determines resonant frequency of tuned circuits, antennas, transmission lines, by-pass condensers, chokes, etc. Measures inductance and capacitance. Also used as a signal generator, wave meter, frequency meter, and in many other applications.

This compact, lightweight grid-dip meter is available in the frequency ranges indicated.

Laboratory Standards

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BOONTON, NEW JERSEY

H. Roy Gray Ltd., 46 Danforth Rd., Toronto 13, Ont. OXford 1-1131

For further information mark No. 31

New products — cont.

Self-adhesive nameplates 137

These aluminum nameplates in thicknesses of 0.003 to 0.006 inch have tough abrasive-resistant coatings. Over 100 standard color combinations are available, including gold and silver. They withstand temperatures from —58 F to +257 F. They have been tested and accepted by CSA and CGA for rating plate applications. A selection of permanent adhesives is available.

GM Aristo-Cals, Willowdale, Ont.

River radar 138

Radar model 215 has been designed as a navigation aid for boats operating along narrow waterways, such as rivers and canals. The radar screen is 23 centimeters and the maximum scale is 400 meters radius. This is the first of seven closely spaced range scales which permit smooth, progressive movement from one scale to the next. On each scale the position of own vessel can be off-centered by half a radius giving nearly double forward lookout. A magnifier, with a ratio of 1.7 to 1, gives a radar presentation of almost double size. Other features include a choice of two pulse lengths, an antenna of high bearing discrimination and low side lobe level, and a control for variable differentiation. This enables the operator to adjust the degree of differentiation applied to the radar signals in order to display a consistently sharp radar picture under all the varying physical conditions which occur in different sections of the inland waterways.

Decca Radar (Canada) Ltd., Toronto.

Microwave power levelers 139

Microwave power leveler series 500 has been developed by Menlo Park Engineering for use in controlling output

variations from traveling wave amplifiers or backward wave oscillators. This is accomplished by a feedback process, whereby a sample of the output power is used to generate an error signal that is impressed on the amplitude modulation element of the twa or bwo. Voltage gain of the 500 series is 80 db maximum with controlled internal feed back for stability. Gain is adjustable over 5 overlapping ranges from 47.0 to 80.0 db. Vernier control allows flexibility of adjustment. Ranges are 50, 60, 65, 70 and 75 db. DC amplifier bandwidth is flat within ±0.5 db from dc to 20 kc; —6 db at 100 kc.

Radionics Ltd., Montreal. END

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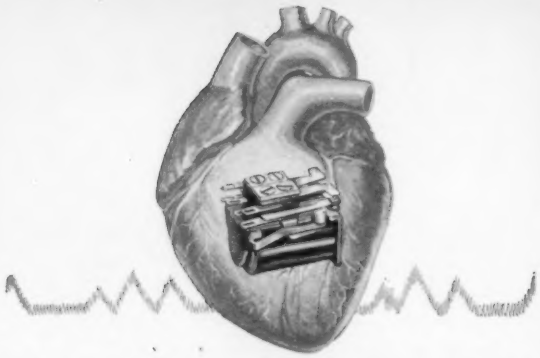

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- Luxo's famous PRECISION SPRING-BALANCED ACTION, the magnifying lamp adjusts easily to any position . . . and STAYS PUT!

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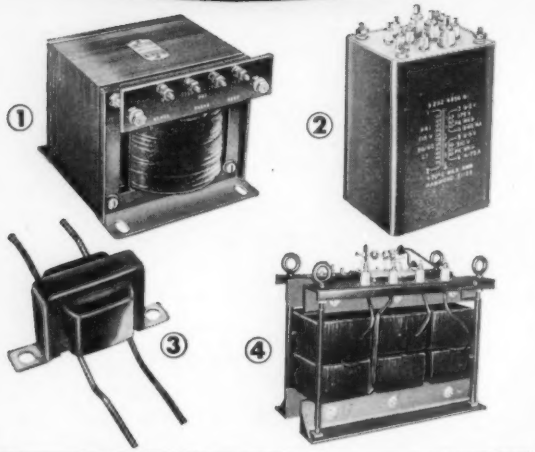

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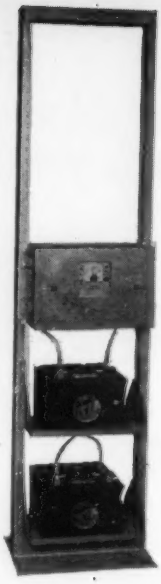

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Communications symposium at Montreal in November

The Montreal Section of the Institute of Radio Engineers is sponsoring a communications symposium to be held at the Queen Elizabeth Hotel, Nov. 4, 5, 1960. Papers will be presented at the technical sessions, and equipment will be exhibited by manufacturers and representatives.

Papers are being sought in the following subject areas: Low frequency communication systems; broadcast communication systems; wire communications; telephone systems; mobile communications; scatter; lunar and space relays; Telex; microwave relays; telemetering.

Prospective authors should submit 50-word summaries of papers and short biographical notes to H. H. Schwartz, Electrodesign, 9124 St. Lawrence Blvd., Montreal, Que. The deadline for these is May 1.

Science fairs

An idea, recently imported from the United States, is providing a wonderful incentive for secondary school students and deserves the support of all Canadian adults. The idea is the science fair—an exhibition of students' scientific projects, experiments or collections.

A project may show original research or be a demonstration of a biological, chemical, physical, mathematical or technical principle, a laboratory or other procedure, an industrial development or an orderly collection of anything in the broad concept of pure or applied science. Exhibits are judged by qualified men and women in the community and the main emphasis is on creative ability and scientific thought.

Science fairs have already been held in Montreal, Sarnia and Winnipeg this year. Others are scheduled for McMasterville, Que., Toronto, Vancouver and Winnipeg (their second).

The rapid growth of the Ontario science fair is typical of the popularity of these annual events. Last year the Rotary Club of Swansea, in association with The Telegram of Toronto, sponsored a science fair for students within Metropolitan Toronto. This year they have extended the fair to any student within Ontario, and at the closing date they had 161 entries under 10 of the 11 different categories. These will be displayed at Exhibition Park, Toronto, April 20-21. A number of companies and organizations have contributed financially, or are supporting the fair in other ways.

Anyone interested in obtaining information about science fairs and how to organize one, should write to the Canadian Science Fairs Council, c/o The Chemical Institute of Canada, 48 Rideau St., Ottawa, Ont.

Ceramic society forms electronics division

The Canadian Ceramic Society has formed an Electronics Division that will be concerned primarily with electronic ceramic manufacturing techniques and problems. Chairman of the new division is H. L. O'Dell, Titania Electric Corp. of Canada Ltd.

Plans are under way to present technical papers and hold panel discussions at future meetings. In addition, the Electronics Division hopes to co-operate with the Institute of Radio Engineers in the presentation of papers on applications of ceramics in electronic equipment.

COMING EVENTS

April

4-8 6th Nuclear Congress, N.Y. Coliseum, New York.

5-9 9th Electrical Engineers Exhibition, Earls Court, London.

12-27 Milan International Trade Fair, Milan, Italy. (Information from Italian Trade Commissioner, Suite 403, 34 King St. East, Toronto.

21-22 Seventh Annual Convention of the Society of Technical Writers and Editors, meeting jointly with the Technical Publishing Society, Drake Hotel, Chicago.

25-27 Fifth Annual National Meeting of the Canadian Electronic Wholesalers' Association, Queen Elizabeth Hotel, Montreal.

May

2-4 National Aeronautical Electronics Conference, Dayton, O.

3-5 8th Annual Conference on Electromagnetic Relays; National Association of Relay Manufacturers, Stillwater, Oklahoma.

9-13 Annual Conference of the Society of Photographic Scientists and Engineers, Miramar Ho- Los Angeles.

Casting waveguide parts

Electronics engineers frequently come up against problems which are outside their normal sphere of operation. Casting metal parts is a good example and W. L. Haney has prepared an interesting paper on investment casting of waveguide parts. It will be featured in the May issue of CEE.

Other papers will describe an emergency power supply for navigational gyros (by A. E. Maine) and new developments in magnetic disc recording (by C. S. Broad).

The Toronto Sections of IRE and AIEE held their annual papers competition Feb. 18, for students from University of Toronto and Ryerson Institute of Technology. Shown getting last-minute instructions from the judges are L. A. C. Weaver, (first prize), C. G. Brace, M. D. Freedman (second) and M. G. M. Whyte (third). Judges are K. MacKenzie, H. Shoemaker and E. A. Ricker.

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1% accuracy 100 μv to 1,000 volts!

Also 2% accuracy, 1 μa to 1 amp full scale.

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No zero adjustment. 1 minute warm-up.

Floating chassis. $1,000 worth of convenience for $350!

Haven't you wished for one compact, simple instrument that would make *precision* dc voltage, dc current and resistance measurements over a wide range?

The new hp 412A is it! In its VTVM circuit, the 412A uses an exclusive hp photo-chopper instead of old-style mechanical vibrators—no drift, no 60 cps pickup. Input is floating, with resistance increasing from 10 megohms on the 1 mv range to 200 megohms on ranges above 100 mv. Current and voltage ranges have a 10 db sequence for maximum readability and overlap. The ohmmeter is a modified Kelvin bridge eliminating lead resistance error; you measure resistance accurately on hook-up wire sections as short as 6".

Model 412A also includes a 1 v or 1 ma recorder output, and 3 separate probes. Call your hp rep today for a demonstration on your bench. Price, $350.

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hp 400H PRECISION VOLTMETER—$325

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hp 400D WIDE RANGE VOLTMETER—$225

Highest quality, extremely versatile. Covers 10 cps to 4 MC. Highly sensitive, accurate to within ±2% to 1 MC. Measures 0.1 mv to 300 v; max. full scale sensitivity 1 mv. Reads direct in dbm. High 10 megohm input impedance virtually eliminates circuit loading. 56 db amplifier feedback insures high stability and freedom from change due to external conditions.

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This advanced design has resulted in a series of four exceptionally stable reflex klystrons covering the 8500 to 11,500 megacycle range at a typical output power level of 75 milliwatts. At vibration levels of 15 to 20G the peak-to-peak deviation of these tubes is less than 50 kilocycles for any vibrating frequency from 20 to 2000 cycles per second, with the force applied in any plane of the tube. The advantage of this low FM noise level in local oscillator service is obvious. Ceramic construction and the superior tube manufacturing techniques it makes possible permit tube or seal temperatures of 250°C without impairment of operation.

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